

# KIC 009644411

## Q1-17 DR25 TCE Parameters

TCE	Run Type	KOI?	Period (Days)	Epoch (BKJD)	Depth (ppm)	Duration (Hours)	MES	SNR	$R_{\star}$ ( $R_{\odot}$ )	$T_{\star}$ (K)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
009644411-01	OBS	7213.01	0.758854	131.949107	352.2	1.584	8.5	8.6	0.67	4331	1.55	685.52
009644411-02	OBS	No	0.758819	131.617809	432.6	1.313	8.2	9.7	0.67	4331	1.73	685.56

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
009644411-01	OBS	FP	0.02	0	0	1	0	MOD_SEC_DV—PLANET_PERIOD_IS_HALF_DV—MOD_SEC_ALT—PLANET_PERIOD_IS_HALF_ALT—HAS_SEC_TCE—CENT_RESOLVED_OFFSET
009644411-02	OBS	FP	0.00	1	1	1	0	IS_SEC_TCE—CENT_RESOLVED_OFFSET

**Notes:** OBS = Observed. INJ = Injected. INV = Inverted. SCR = Scrambled.

N = Not Transit-Like. S = Stellar Eclipse. C = Centroid Offset. E = Ephemeris Match.

See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

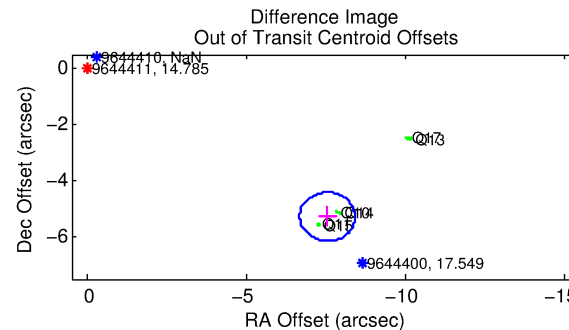
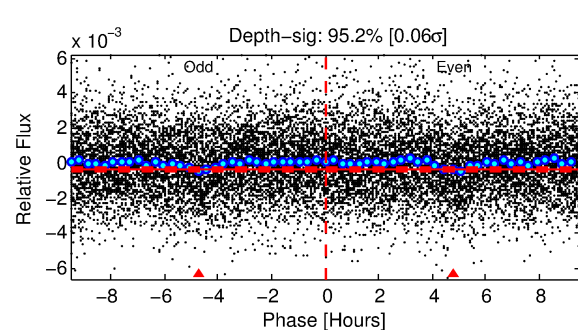
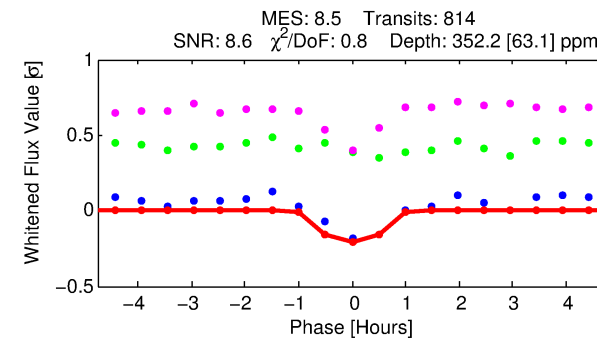
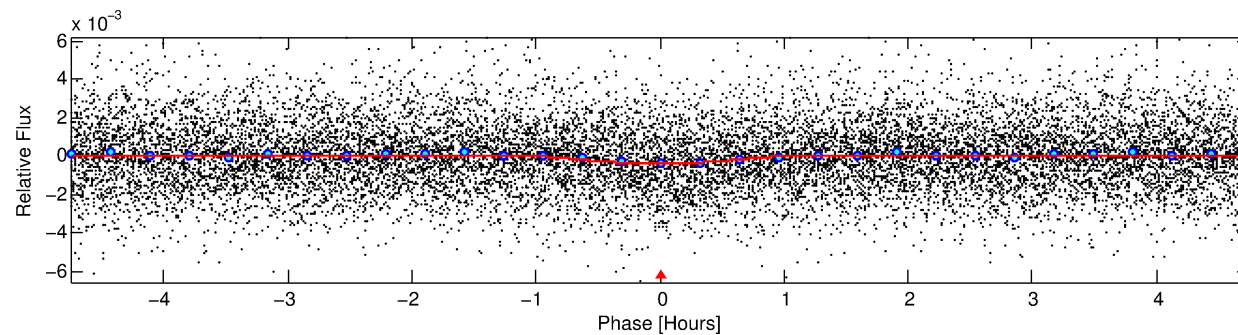
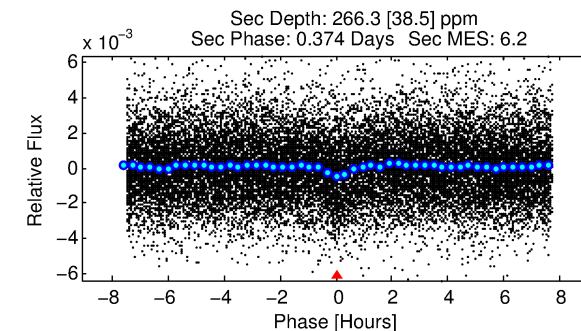
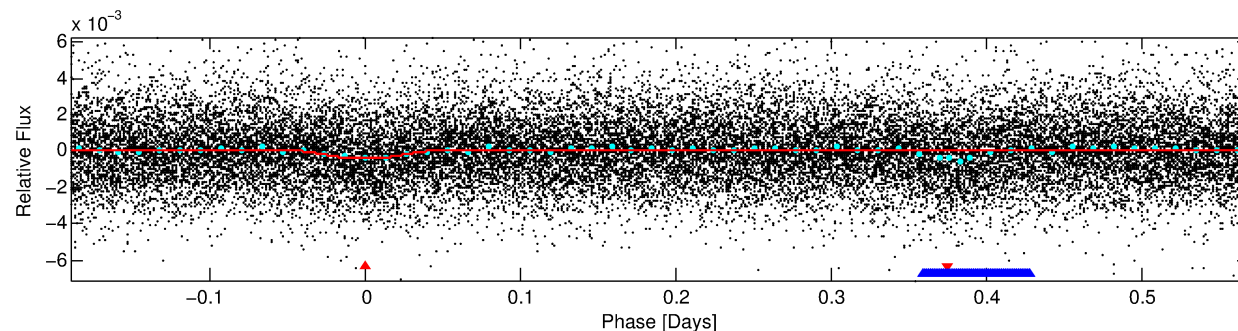
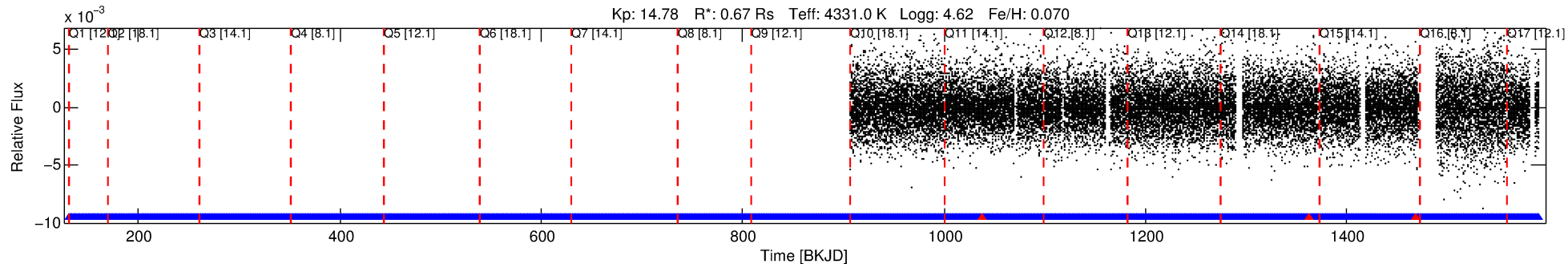
## Ephemeris Match Information For 009644411-01

No Significant Match Found

# DV One-Page Summary

KIC: 9644411 Candidate: 1 of 2 Period: 0.759 d  
KOI: K07213 Corr: No Ephemeris Match

Kp: 14.78 R\*: 0.67 Rs Teff: 4331.0 K Logg: 4.62 Fe/H: 0.070



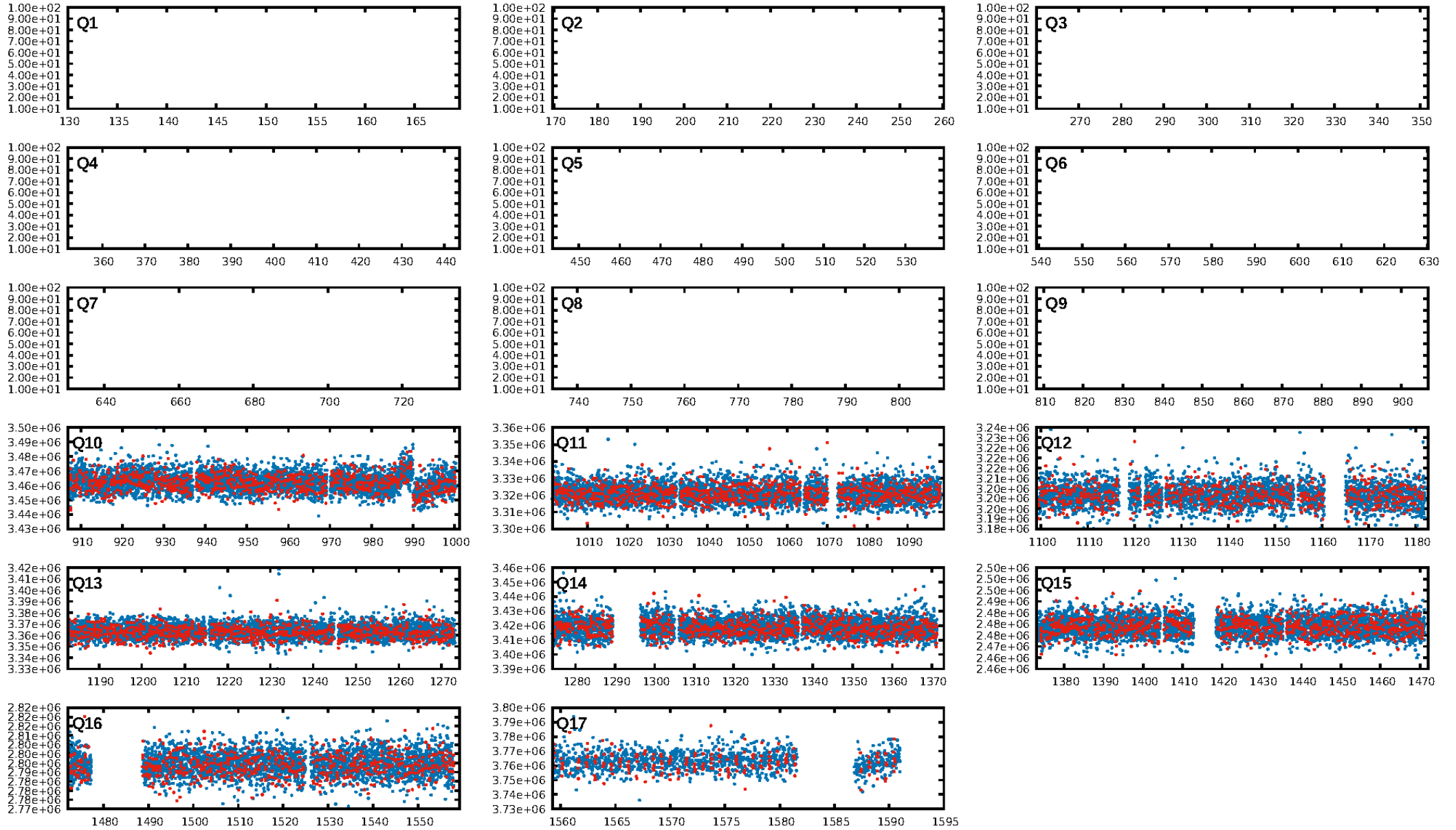
## DV Fit Results:

Period = 0.75885 [0.00001] d  
Epoch = 131.9491 [0.0027] BKJD  
Rp/R\* = 0.0213 [0.0253]  
a/R\* = 2.00 [6.51]  
b = 0.90 [0.95]  
Seff = 685.52 [120.10]  
Teq = 1305 [57] K  
Rp = 1.55 [1.84] Re  
a = 0.0143 [0.0009] AU  
Ag = 12.46 [29.67] [0.39σ]  
Teff = 3790 [2259] K [1.10σ]

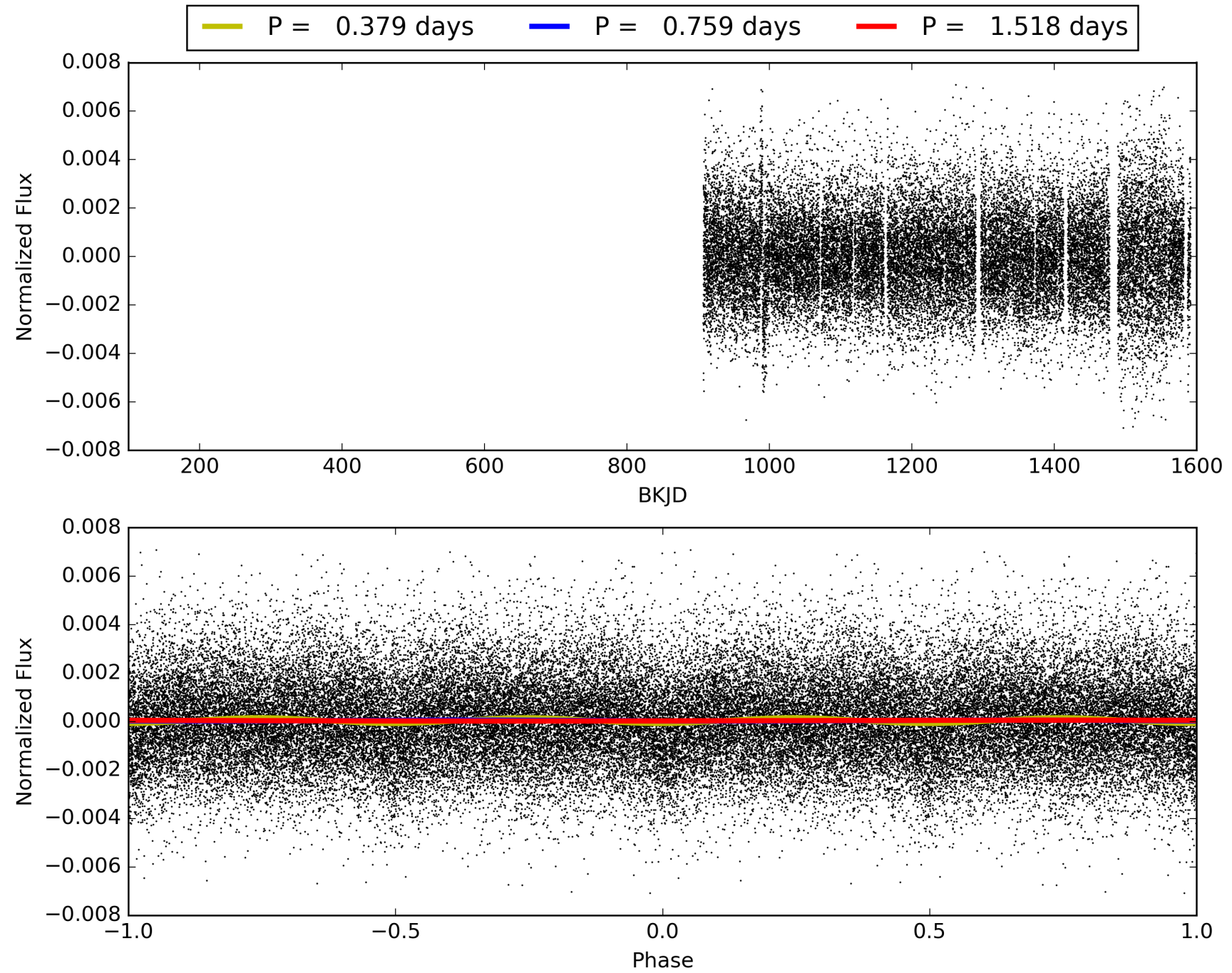
## DV Diagnostic Results:

ShortPeriod-sig: 0.0% [0.00σ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: N/A  
ModelChiSquareGof-sig: N/A  
Bootstrap-pfa: 1.52e-23  
RollingBand-fgt: 1.00 [776/779]  
GhostDiagnostic-chr: -0.9169  
Centroid-sig: 0.0%  
Centroid-so: 7.452 arcsec [5.42σ]  
OotOffset-rm: 9.202 arcsec [31.77σ]  
KicOffset-rm: 10.258 arcsec [144.88σ]  
OotOffset-st: 2/2/0/2 [6]  
KicOffset-st: 2/2/0/2 [6]  
DiffImageQuality-fgm: 1.00 [6/6]  
DiffImageOverlap-fno: 1.00 [8/8]

# TCE 009644411-01, PDC Light Curves

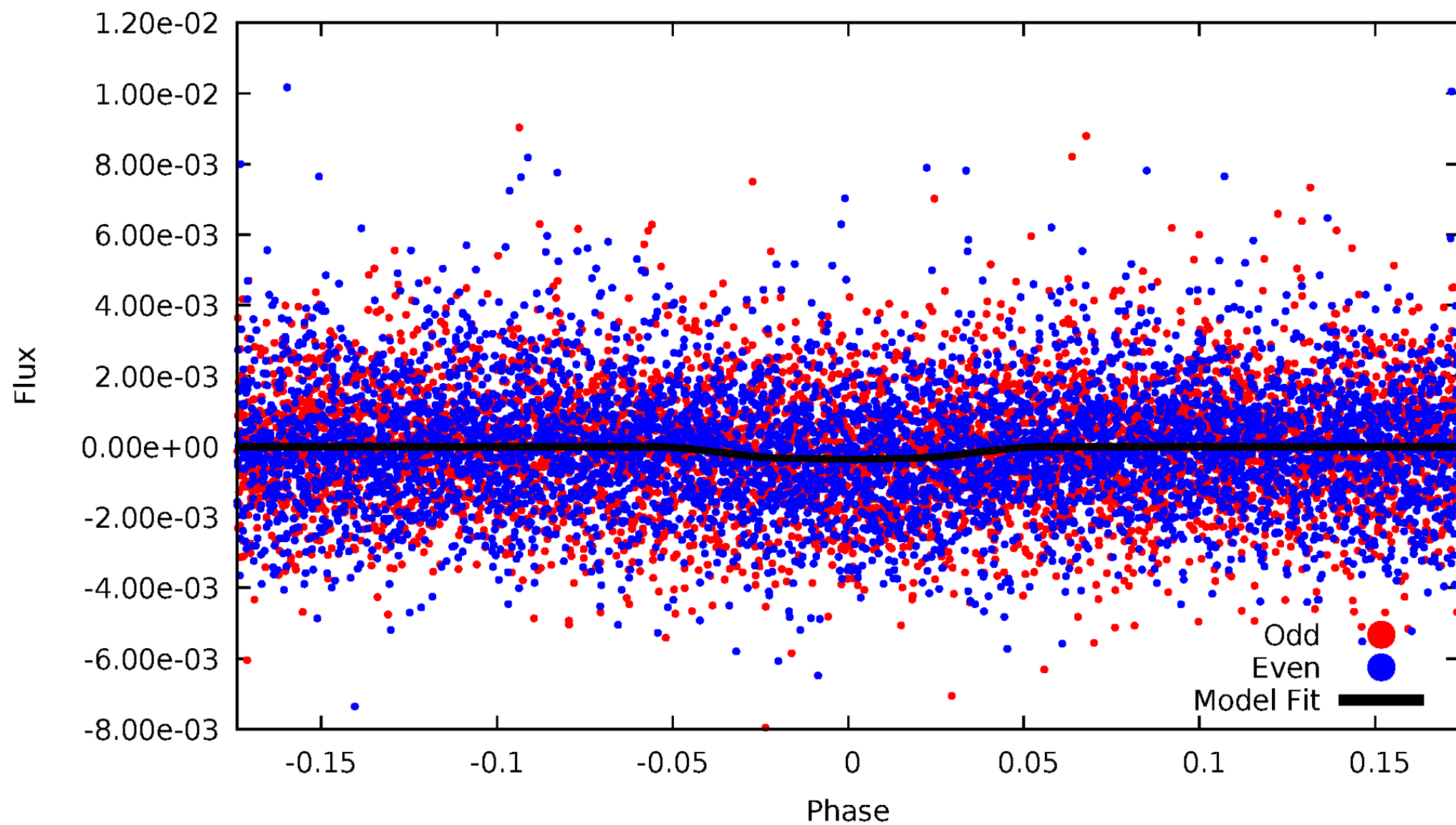


TCE 009644411-01



# DV Odd/Even

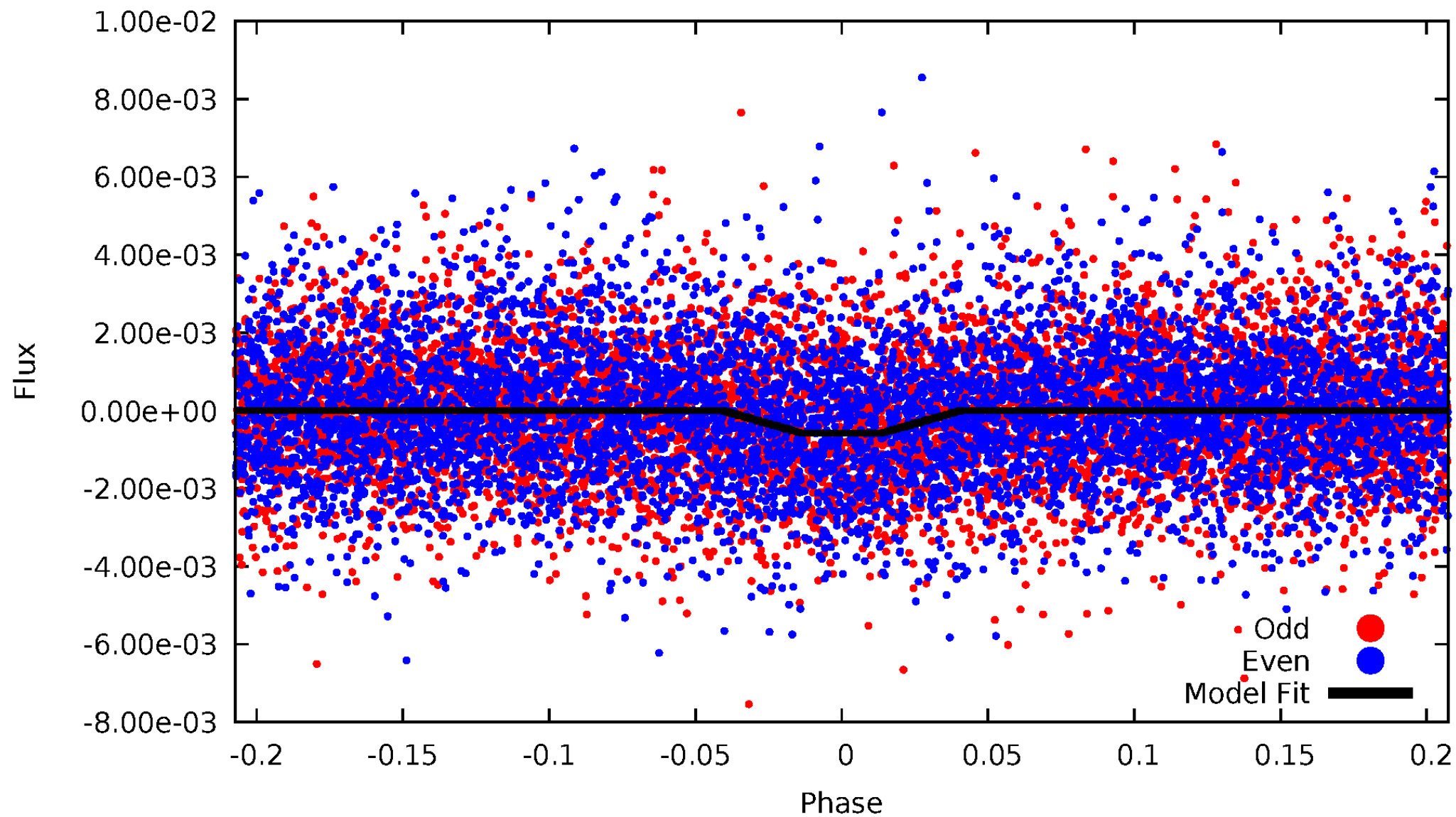
TCE 009644411-01



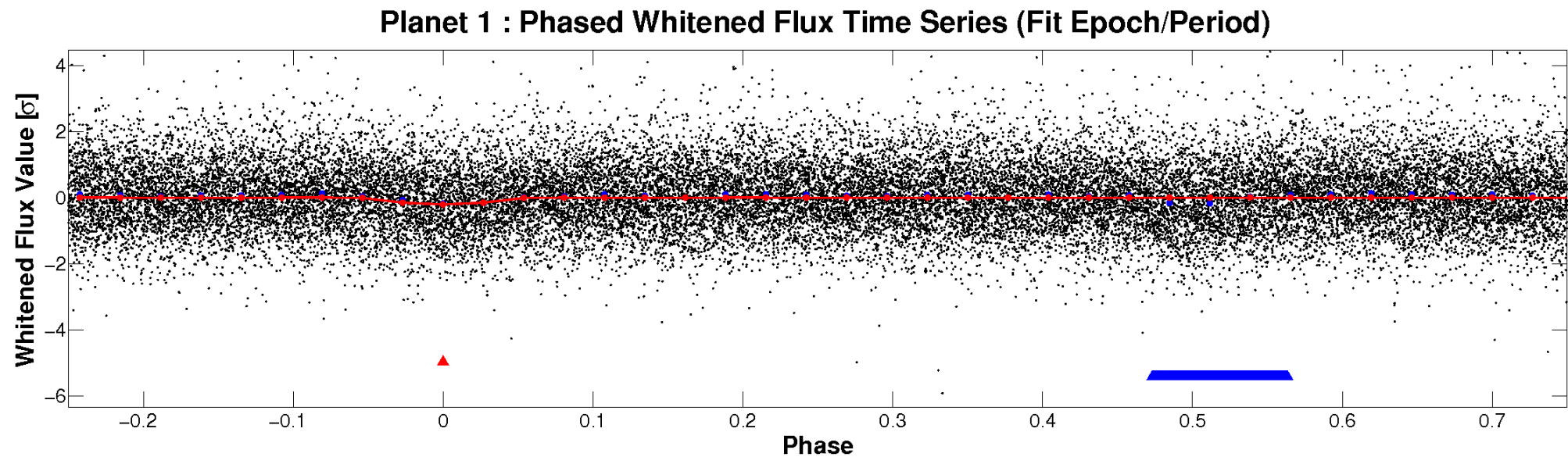
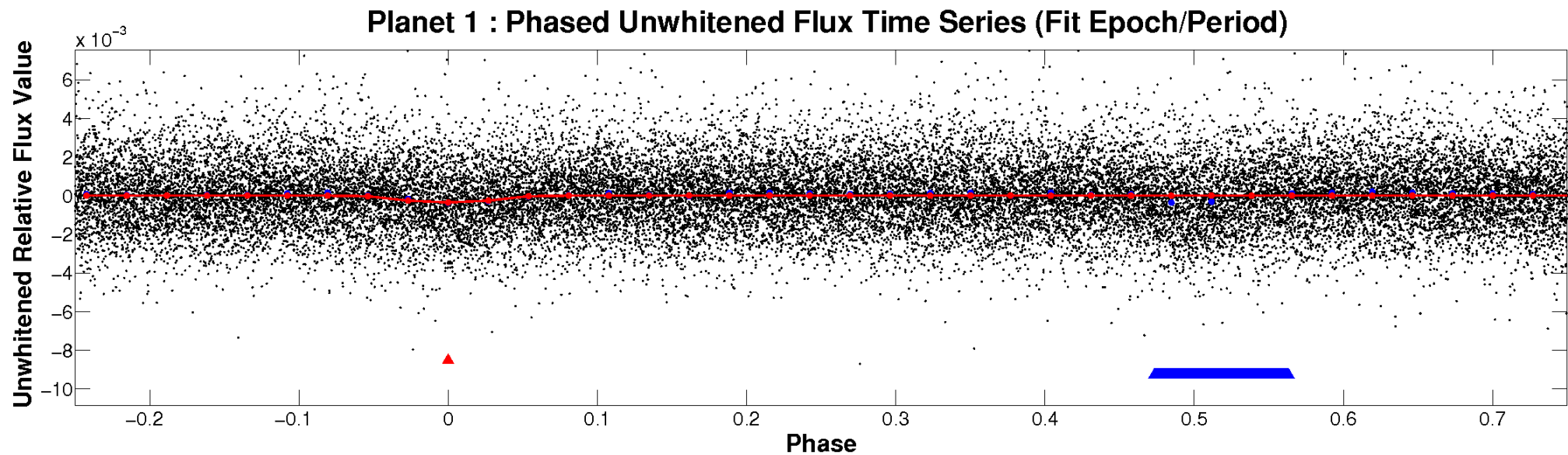


# ALT Odd/Even

TCE 009644411-01

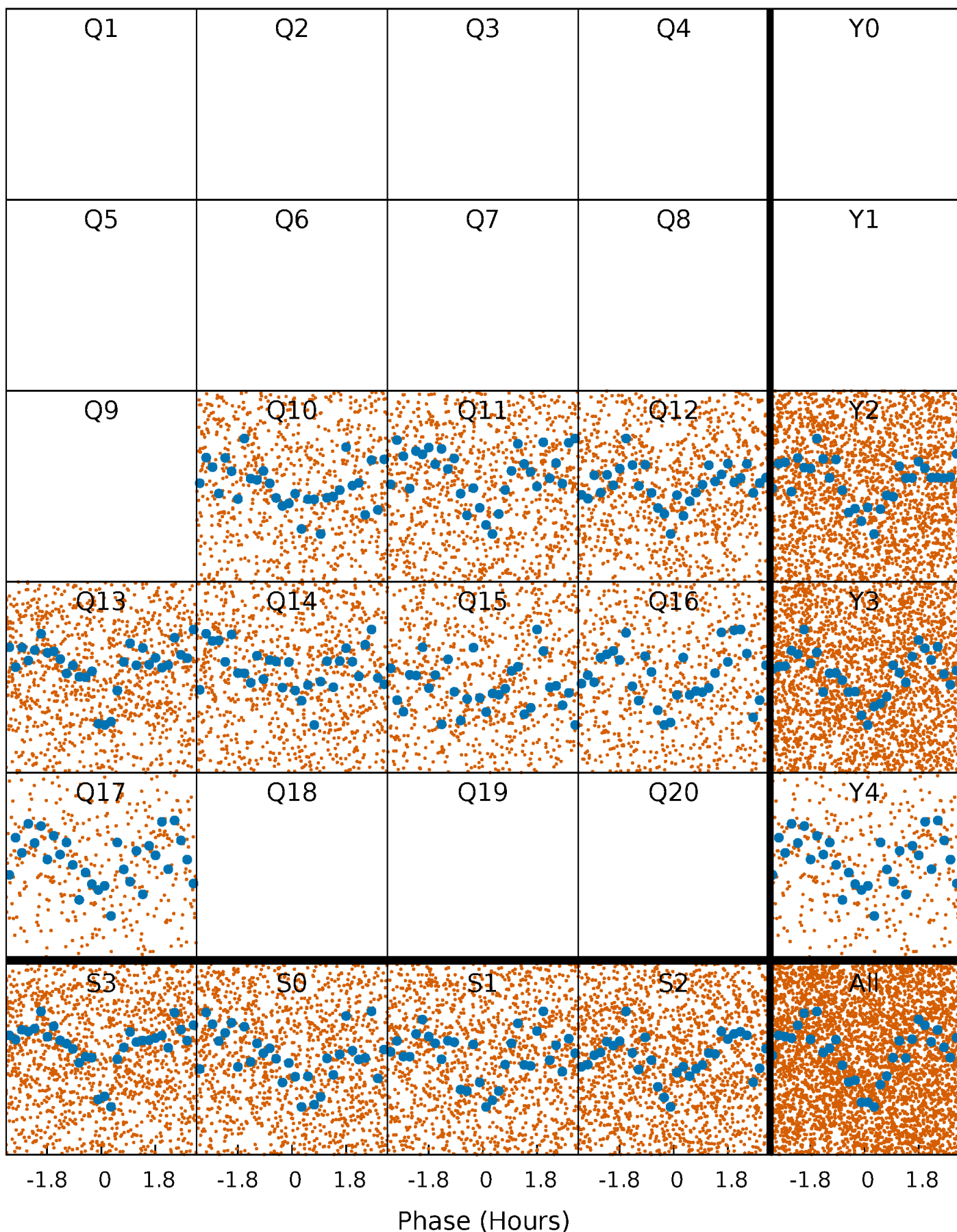


# Non-Whitened Vs. Whitened Light Curve



# PDC Quarter-Phased Transit Curves

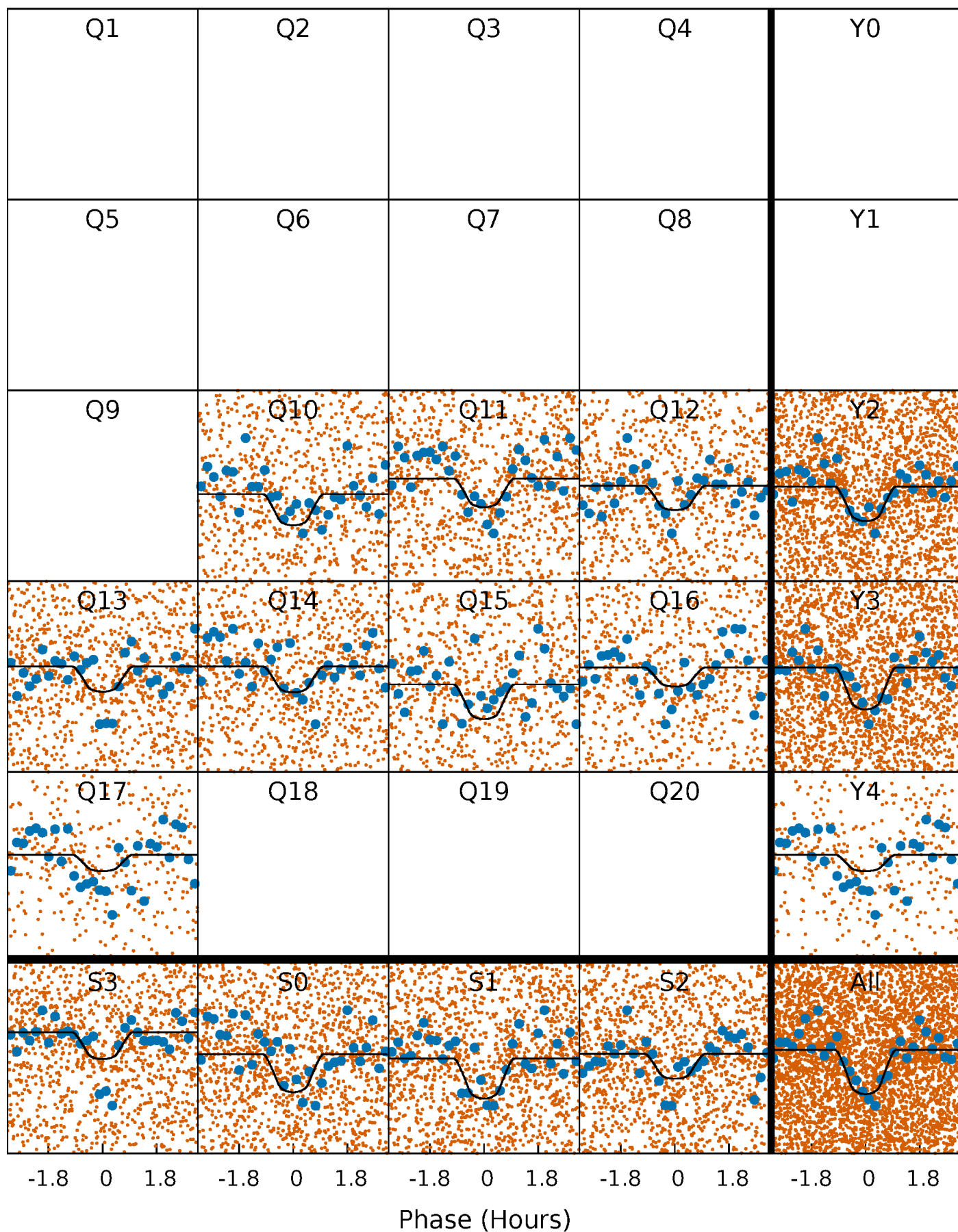
TCE 009644411-01 P= 0.758854 Days  $T_0=131.949107$  (BKJD)





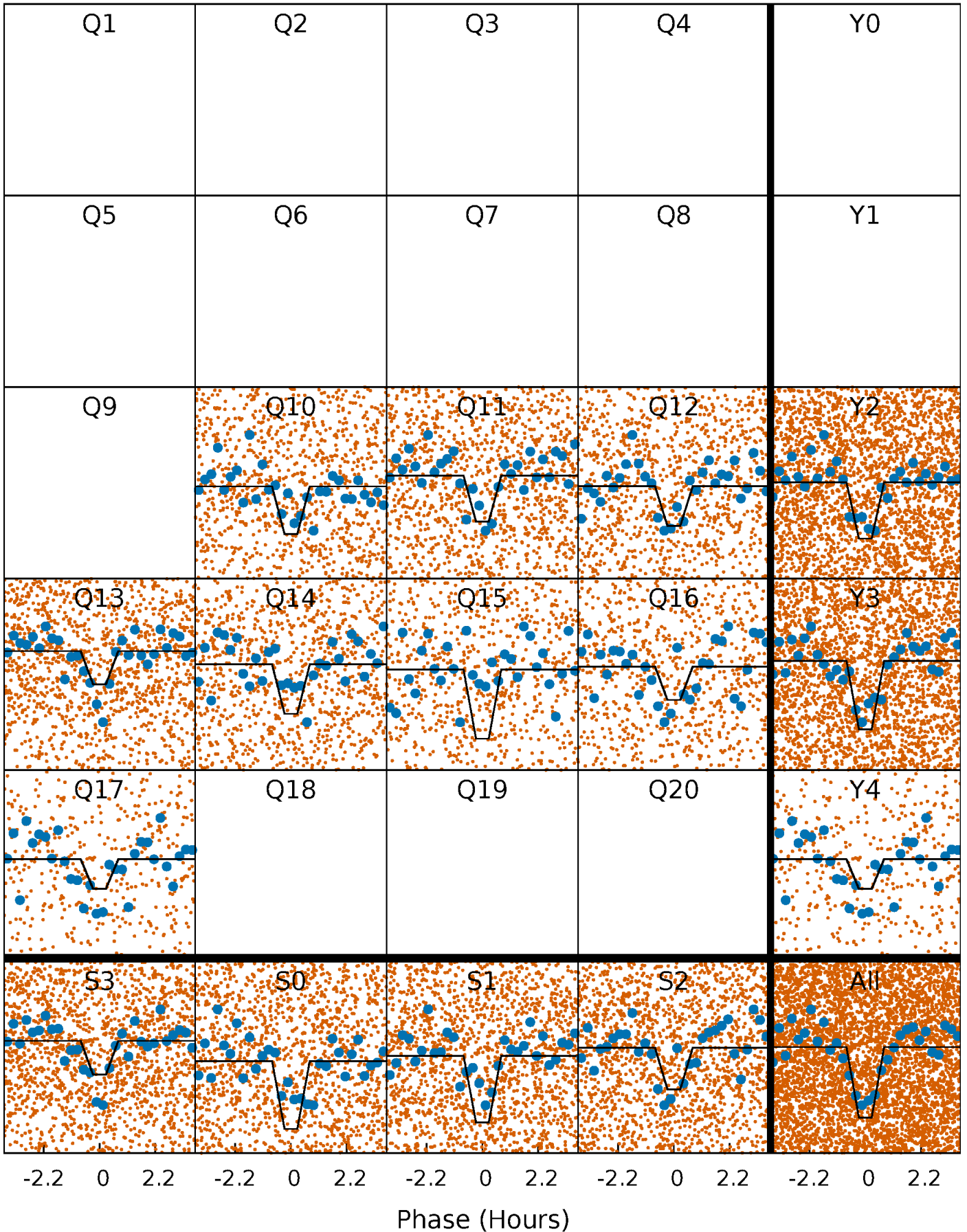
# DV Quarter-Phased Transit Curves

TCE 009644411-01   P= 0.758854 Days    $T_0=131.949107$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

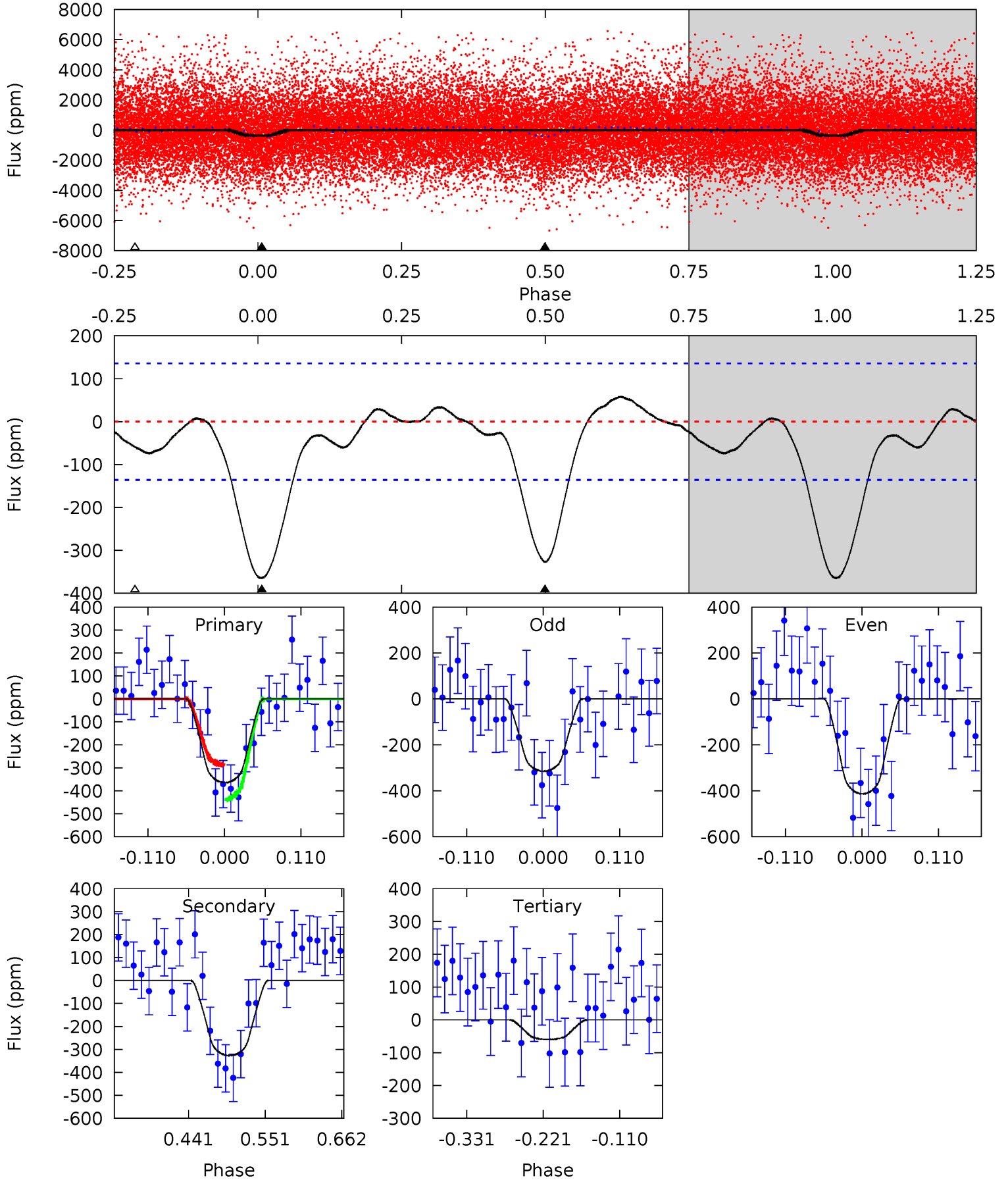
TCE 009644411-01   P= 0.758859 Days    $T_0=131.947002$  (BKJD)



# DV Model-Shift Uniqueness Test

009644411-01, P = 0.758854 Days, E = 131.949107 Days

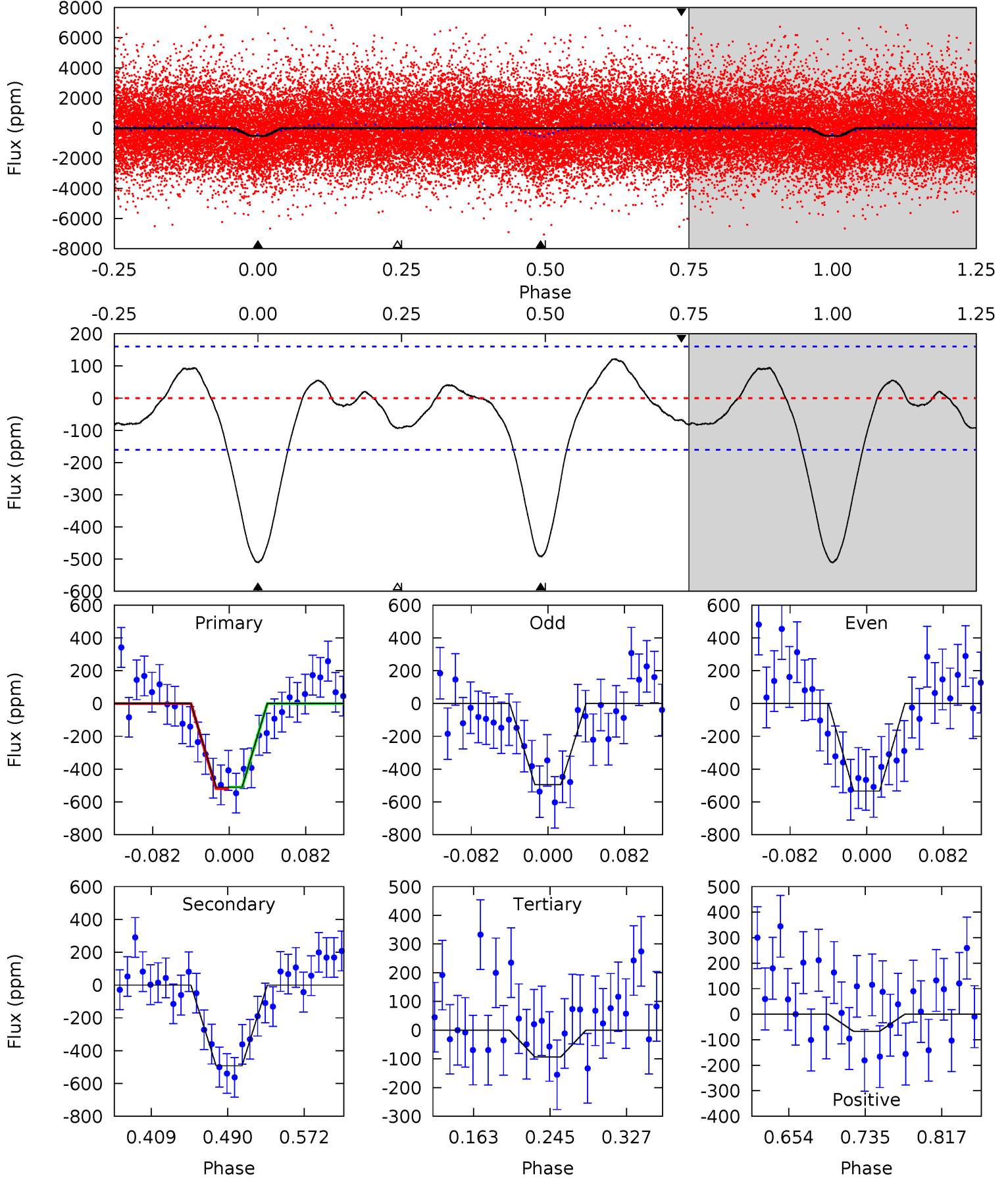
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
12.2	11.0	2.00	0	4.54	1.60	1.18	10.2	12.2	8.96	11.0	1.66	0.94	0.14	2.52



# Alt Model-Shift Uniqueness Test

009644411-01, P = 0.758859 Days, E = 131.947002 Days

Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
14.7	14.1	2.68	-1.93	4.61	1.74	1.67	12.0	16.6	11.5	16.1	0.56	0.90	0.19	0.12





### Stellar Parameters For KIC 009644411

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$4331^{+151}_{-166}$	$4.620^{+0.042}_{-0.025}$	$0.070^{+0.250}_{-0.300}$	$0.666^{+0.041}_{-0.055}$	$0.675^{+0.051}_{-0.062}$	$3.216^{+0.634}_{-0.321}$
	+3%/-4%	+1%/-1%	+357%/-429%	+6%/-8%	+8%/-9%	+20%/-10%
Source	PHO54	PHO54	PHO54	DSEP		

KIC = Kepler Input Catalog; PHO = Photometry; SPE = Spectroscopy; AST = Asteroseismology  
 TRA = Transits; DESP = Dartmouth Models; MULT = Multiple Models

### Secondary Eclipse Parameters for KIC 009644411-01 / KOI 7213.01

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{\text{max}} (K)$	$T_{\text{obs}} (K)$	$A_{\text{obs}}$
DV	$-327 \pm 30$	$2.03^{+1.62}_{-1.30}$	$1819^{+68}_{-72}$	$3662^{+1884}_{-616}$	$8.823^{+60.961}_{-6.089}$
Alt.	$-492 \pm 35$	$2.09^{+1.69}_{-1.28}$	$1818^{+68}_{-74}$	$3913^{+1929}_{-705}$	$13^{+75}_{-9}$

$T_{\text{max}}$  = Theoretical Maximum Planetary Temperature

$T_{\text{obs}}$  = Observed Planetary Temperature (Assuming  $A=0.3$ )

$A_{\text{obs}}$  = Observed Albedo (Assuming  $T=0$ )

If a secondary eclipse is present, the system is likely an EB if  $T_{\text{obs}} \gg T_{\text{max}}$  AND  $A_{\text{obs}} \gg 1.0$

## DV Centroid Data

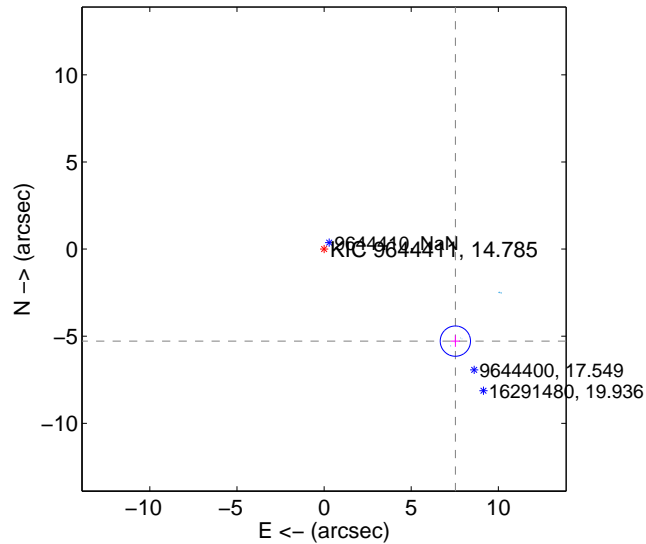
Supplemental centroid analysis for 009644411-01. Kepler magnitude: 14.79. Transit SNR 8.56

There are 6 quarters with good PRF difference image offsets

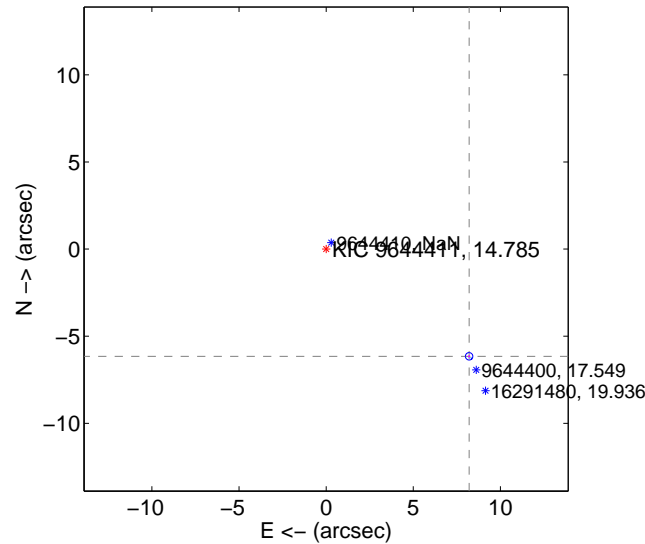
The OOT PRF centroid is offset from the target star catalog position by about 4.15 arcsec so the offset from difference PRF-fit to OOT-fit may be invalid.

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$9.202 \pm 0.290$	31.77	$-7.535 \pm 0.268$	$-5.283 \pm 0.330$
PRF-fit source offset from KIC position	$10.258 \pm 0.071$	144.88	$-8.207 \pm 0.070$	$-6.154 \pm 0.068$
photometric centroid source offset	$7.45 \pm 1.37$	5.42	$-6.22 \pm 1.41$	$-4.11 \pm 1.29$

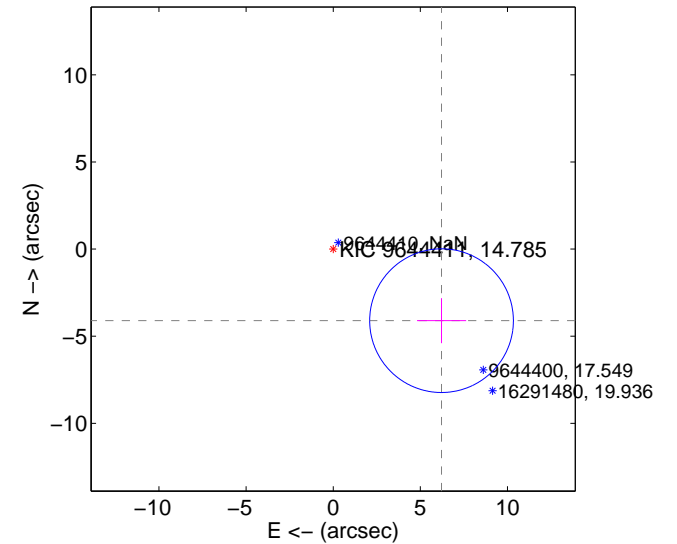
offset from difference PRF-fit to OOT PRF-fit



offset from difference PRF-fit to KIC position



offset from photometric centroids



Centroid source offsets from the target star reconstructed from PRF and photometric centroids. Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three- $\sigma$ . Red \*: target star. Blue \*: Other stars. Text next to a star gives its KIC ID and kepmag. KIC IDs > 15,000,000 are from the UKIRT catalog.

white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

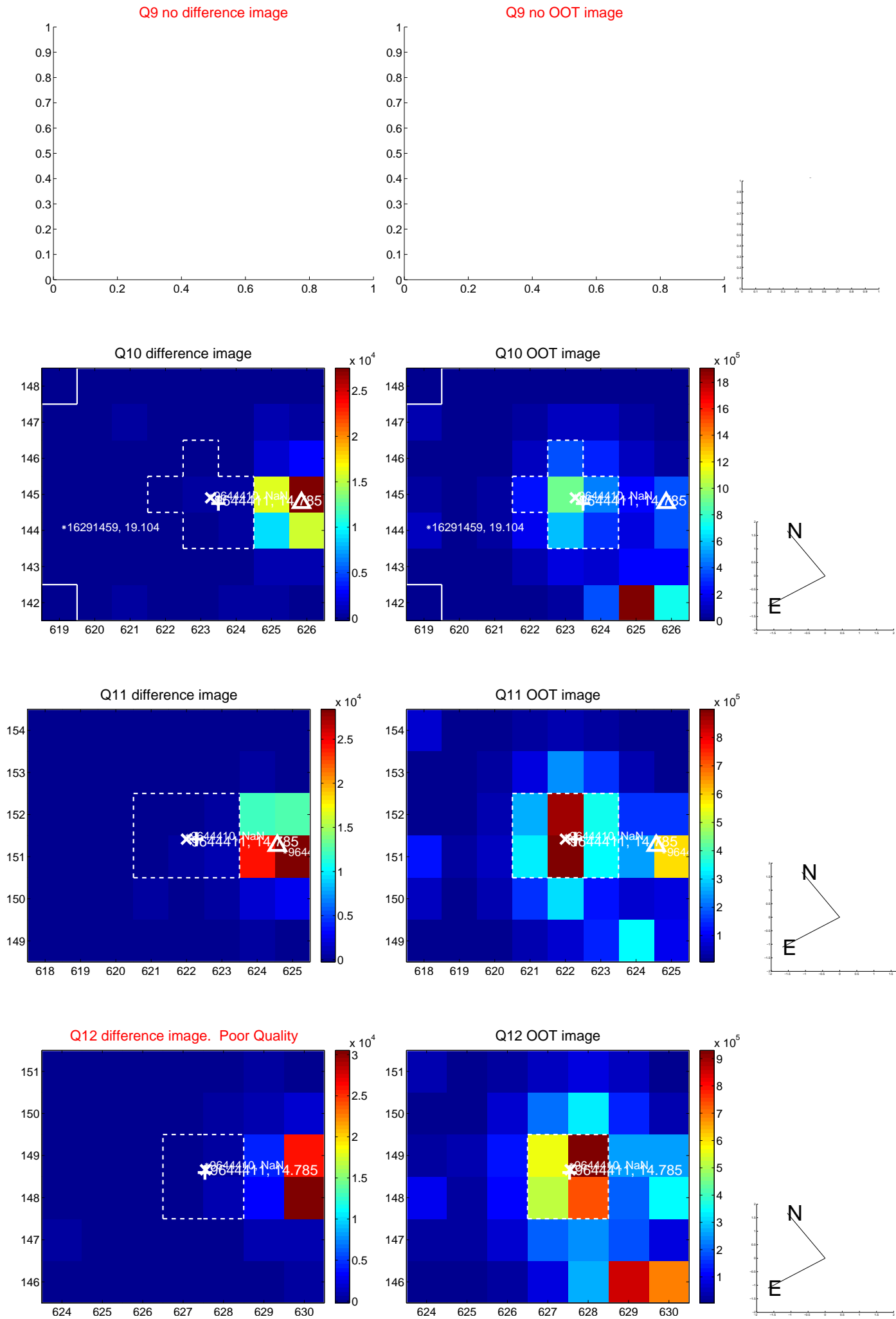


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

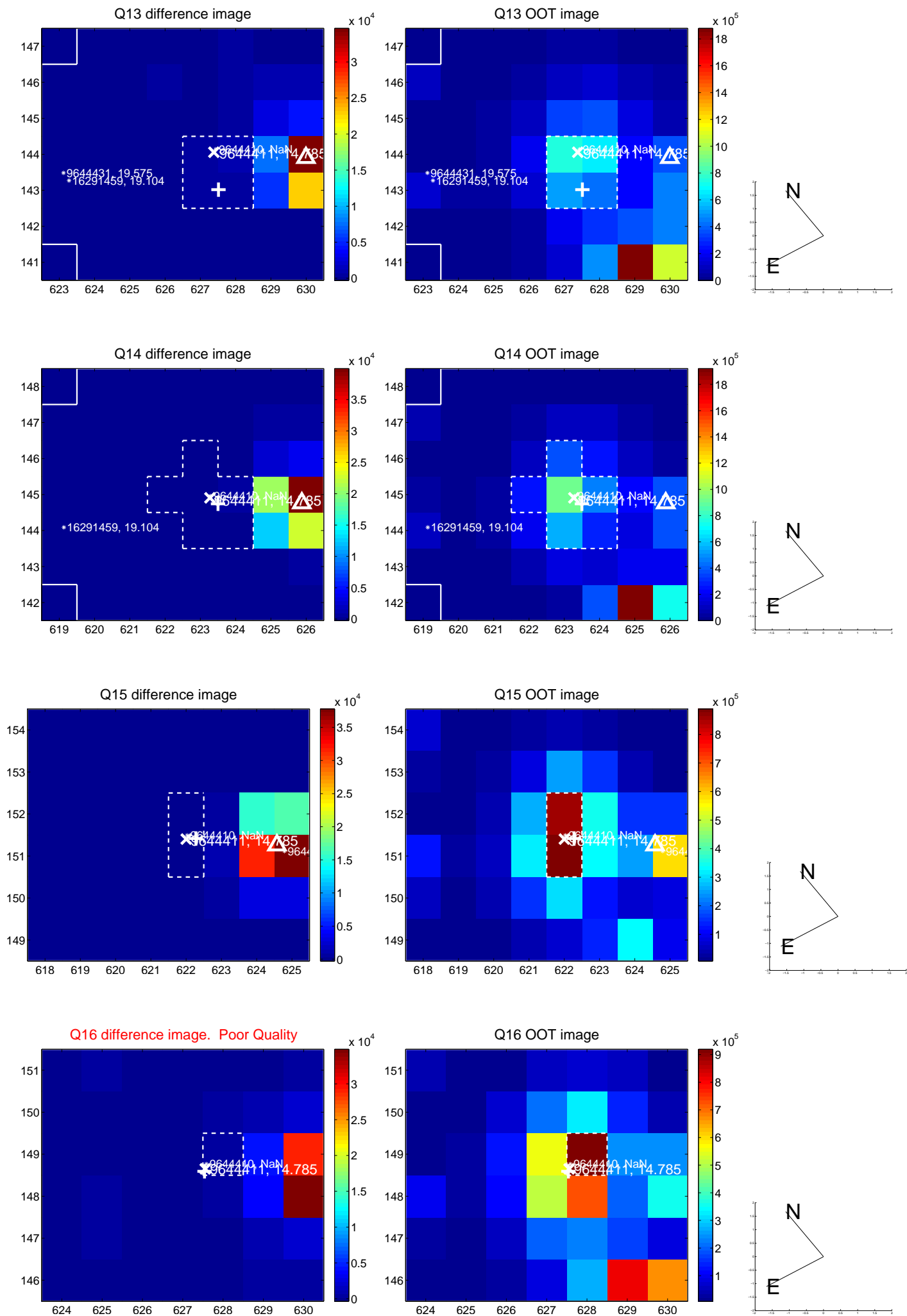




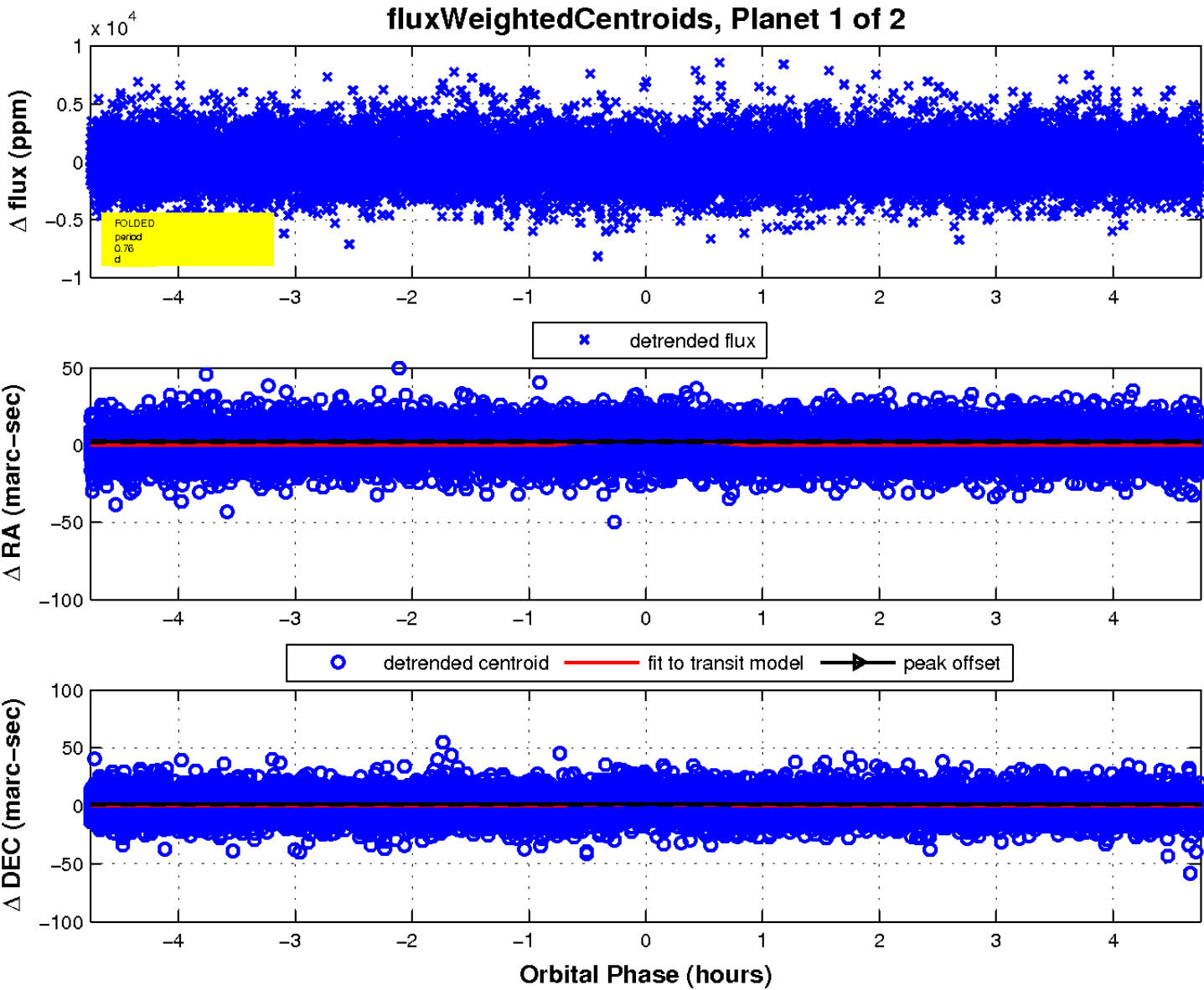
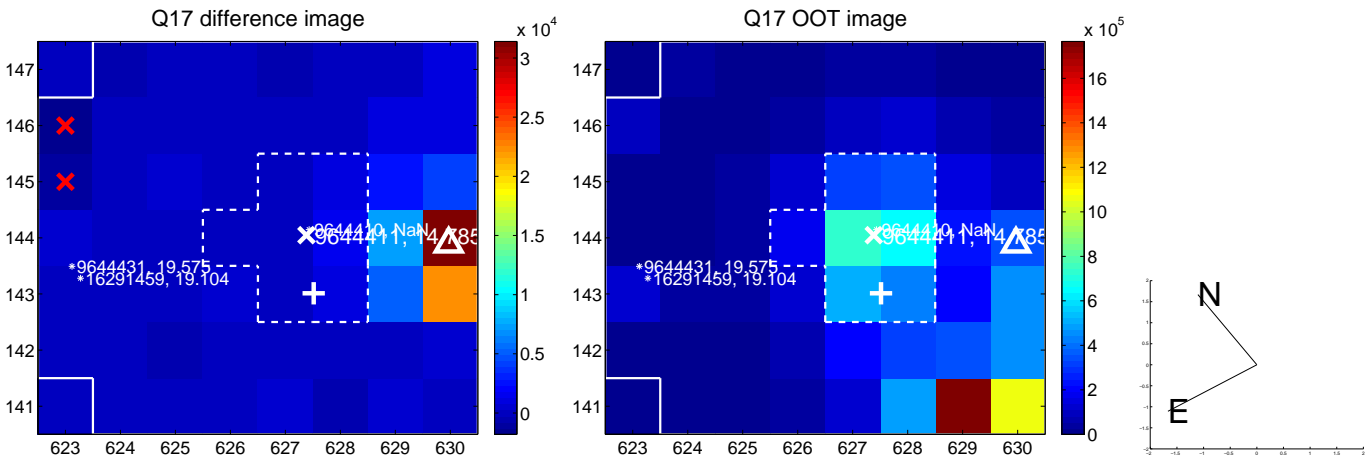
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

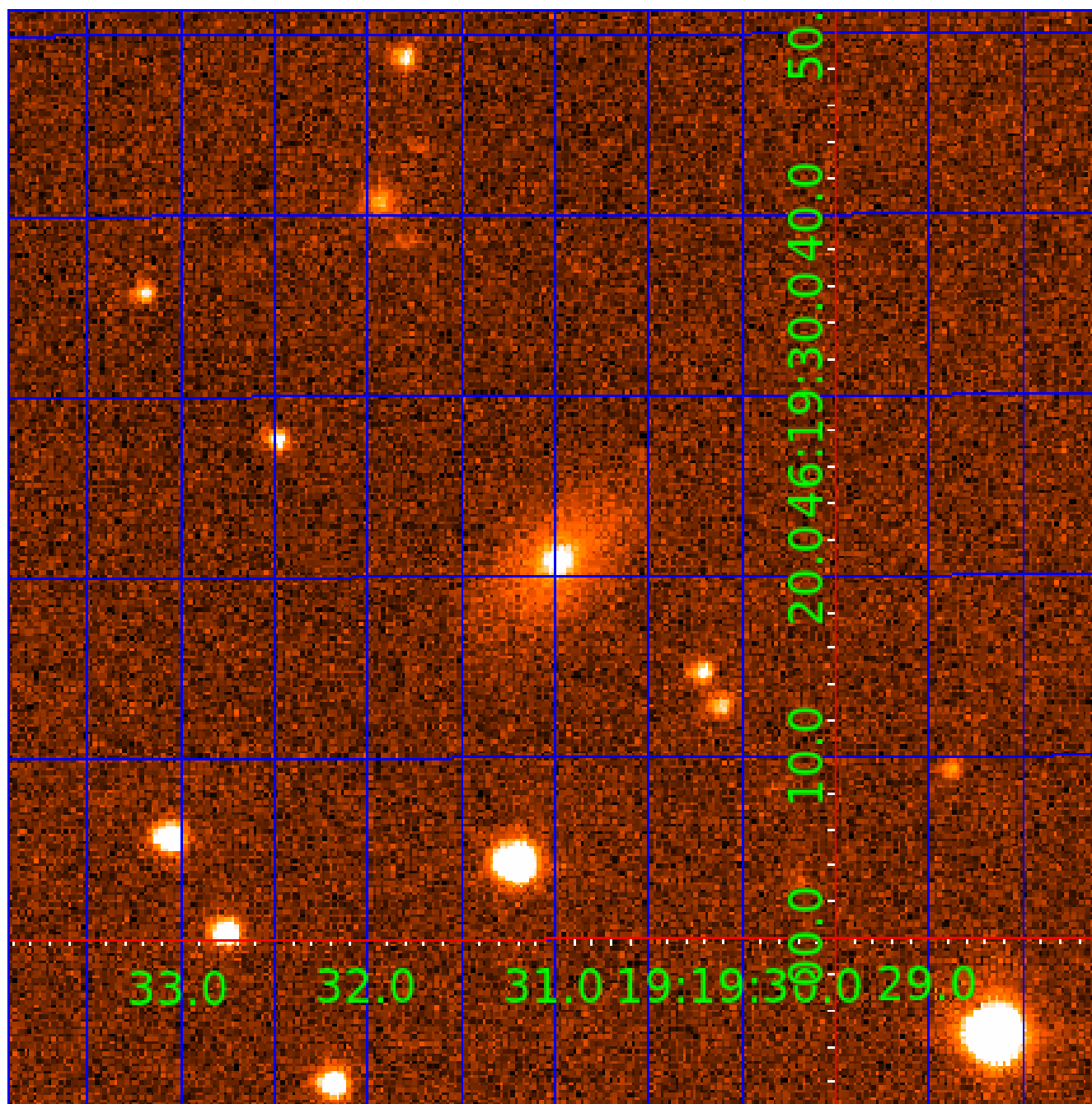


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



UKIRT Image

Declination





# KIC 009644411

## Q1-17 DR25 TCE Parameters

TCE	Run Type	KOI?	Period (Days)	Epoch (BKJD)	Depth (ppm)	Duration (Hours)	MES	SNR	$R_{\star}$ ( $R_{\odot}$ )	$T_{\star}$ (K)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
009644411-01	OBS	7213.01	0.758854	131.949107	352.2	1.584	8.5	8.6	0.67	4331	1.55	685.52
009644411-02	OBS	No	0.758819	131.617809	432.6	1.313	8.2	9.7	0.67	4331	1.73	685.56

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
009644411-01	OBS	FP	0.02	0	0	1	0	MOD_SEC_DV—PLANET_PERIOD_IS_HALF_DV—MOD_SEC_ALT—PLANET_PERIOD_IS_HALF_ALT—HAS_SEC_TCE—CENT_RESOLVED_OFFSET
009644411-02	OBS	FP	0.00	1	1	1	0	IS_SEC_TCE—CENT_RESOLVED_OFFSET

**Notes:** OBS = Observed. INJ = Injected. INV = Inverted. SCR = Scrambled.

N = Not Transit-Like. S = Stellar Eclipse. C = Centroid Offset. E = Ephemeris Match.

See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

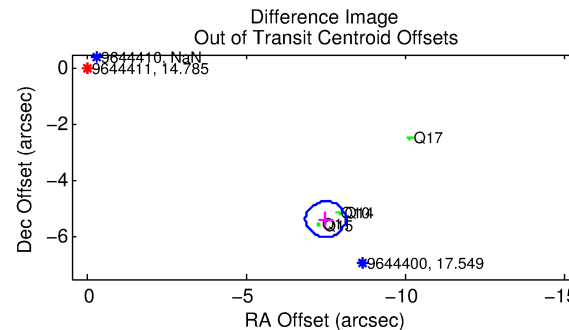
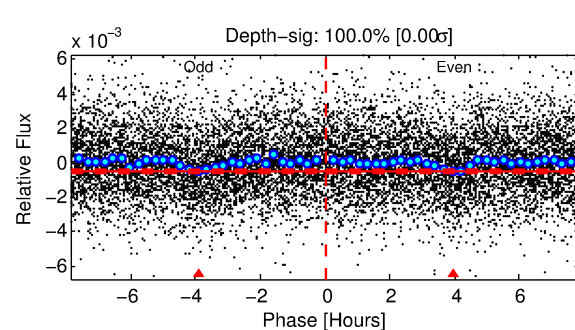
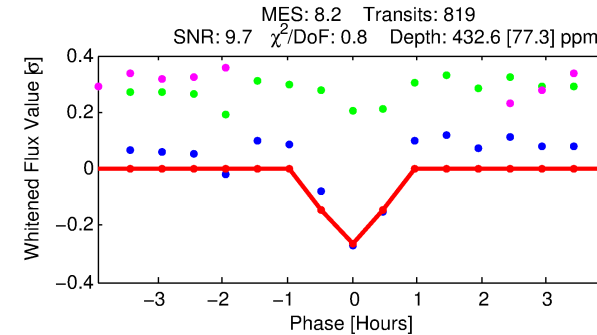
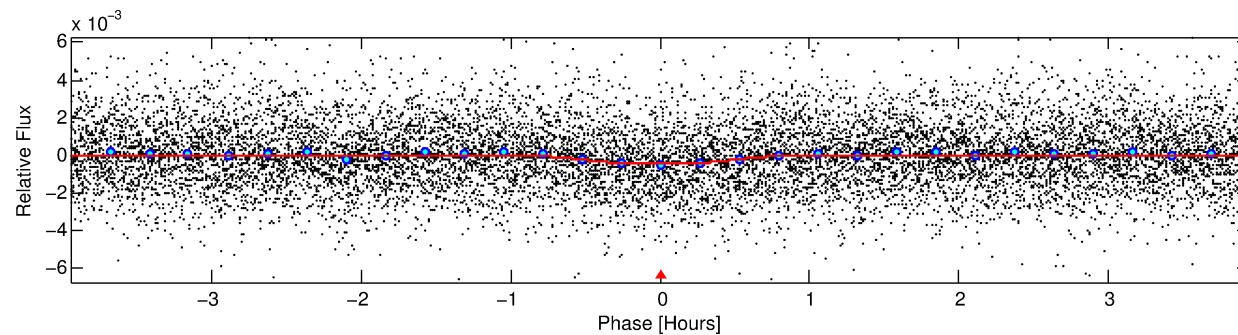
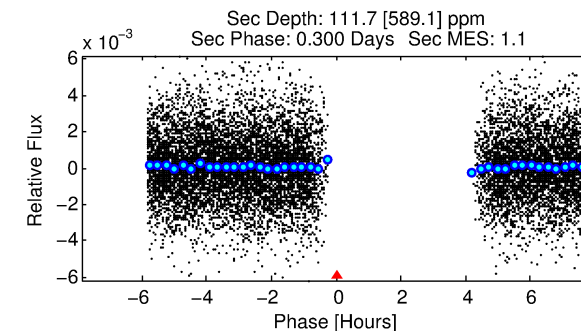
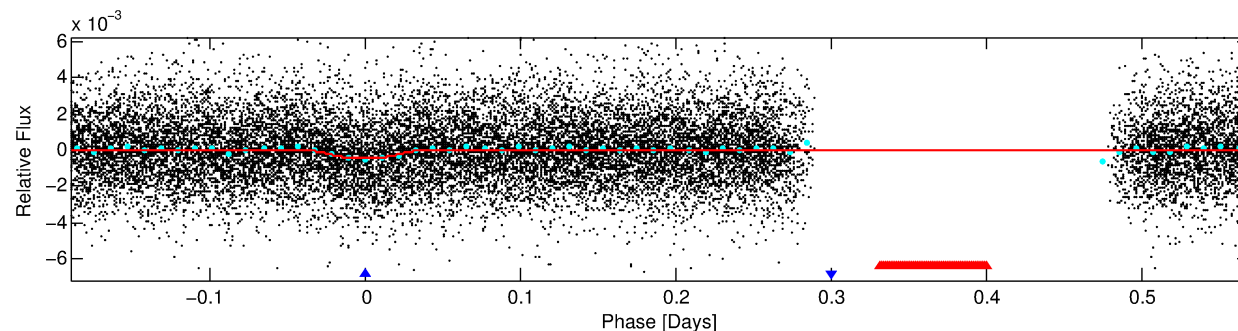
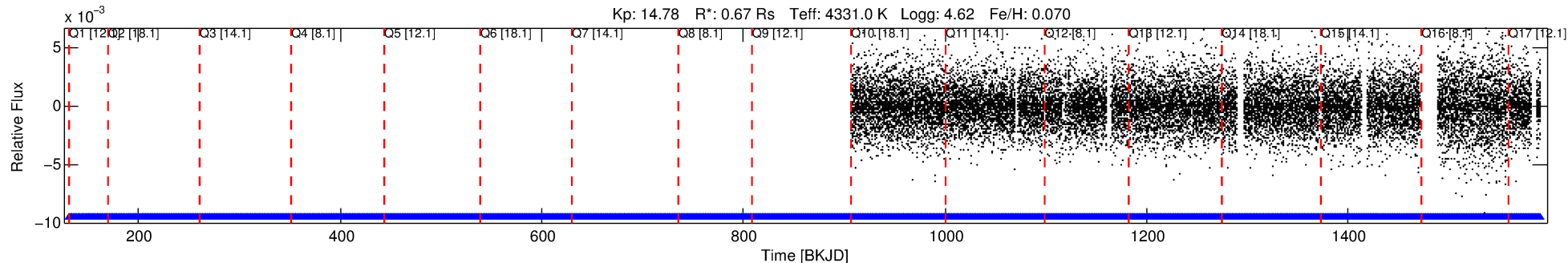
## Ephemeris Match Information For 009644411-02

No Significant Match Found

# DV One-Page Summary

KIC: 9644411 Candidate: 2 of 2 Period: 0.759 d  
KOI: K07213.01 Corr: 0.950

Kp: 14.78 R\*: 0.67 Rs Teff: 4331.0 K Logg: 4.62 Fe/H: 0.070



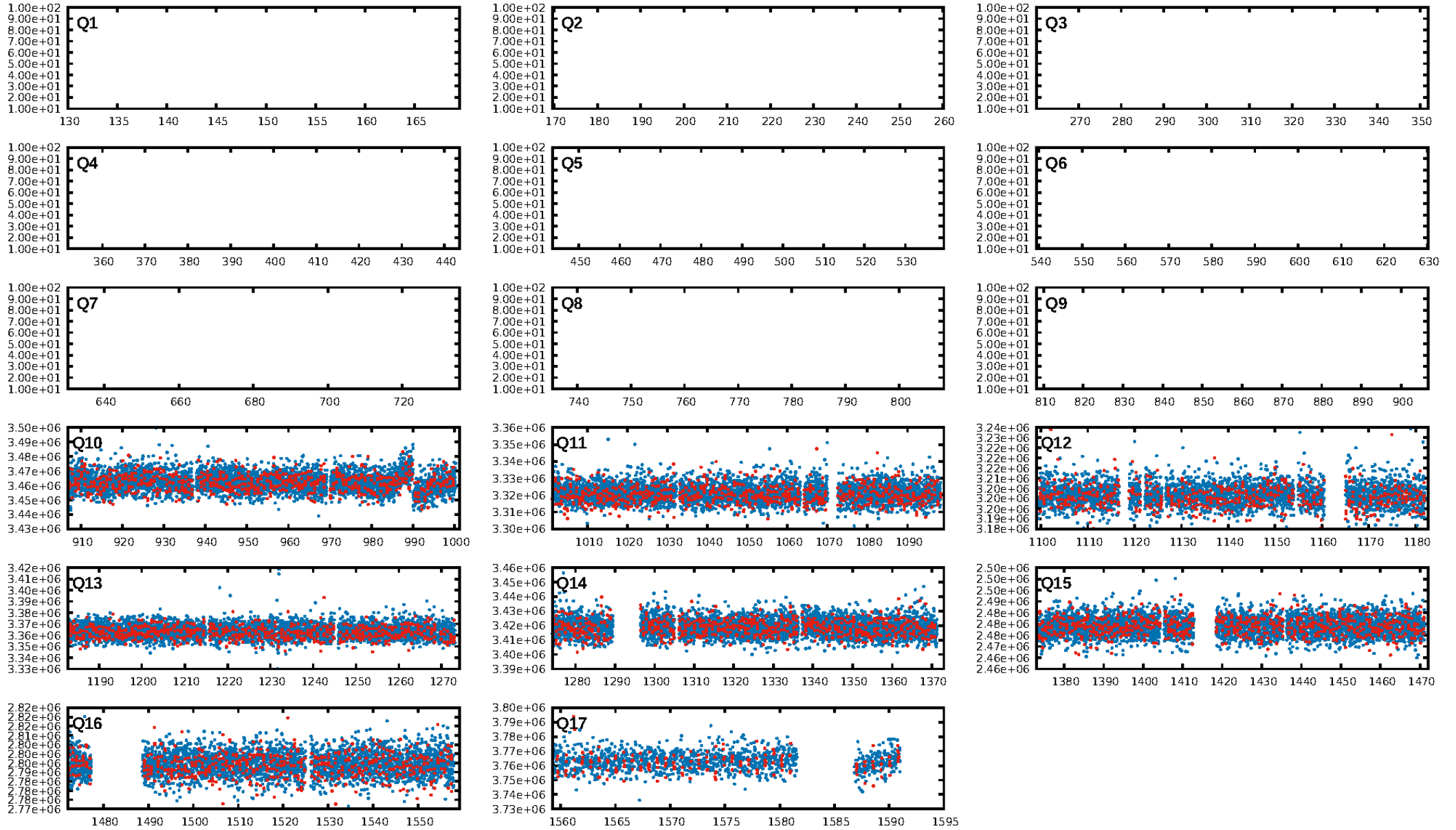
## DV Fit Results:

Period = 0.75882 [0.00001] d  
Epoch = 131.6178 [0.0022] BKJD  
Rp/R\* = 0.0237 [0.0251]  
a/R\* = 2.33 [7.30]  
b = 0.90 [0.82]  
Seff = 685.56 [120.11]  
Teq = 1305 [57] K  
Rp = 1.73 [1.83] Re  
a = 0.0143 [0.0009] AU  
Ag = 4.21 [23.91] [0.13σ]  
Teffp = 2889 [4105] K [0.39σ]

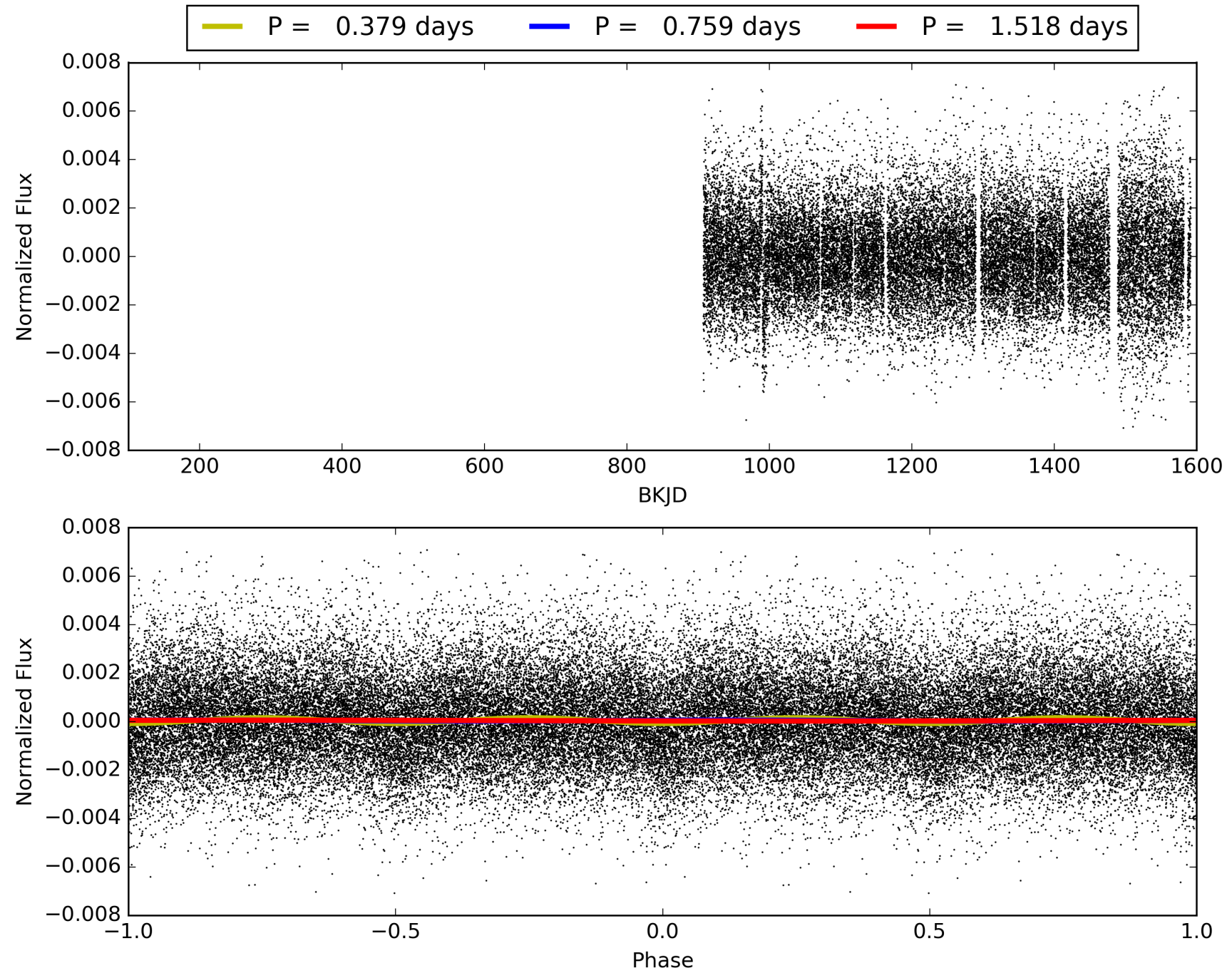
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 0.0% [0.00σ]  
ModelChiSquare2-sig: N/A  
ModelChiSquareGof-sig: N/A  
Bootstrap-pfa: 2.94e-22  
RollingBand-fgt: 1.00 [784/784]  
GhostDiagnostic-chr: -0.3208  
Centroid-sig: 0.0%  
Centroid-so: 7.671 arcsec [6.25σ]  
OotOffset-rm: 9.208 arcsec [43.80σ]  
KicOffset-rm: 10.258 arcsec [142.68σ]  
OotOffset-st: 2/2/0/1 [5]  
KicOffset-st: 2/2/0/1 [5]  
DiffImageQuality-fgm: 1.00 [5/5]  
DiffImageOverlap-fno: 1.00 [8/8]

# TCE 009644411-02, PDC Light Curves



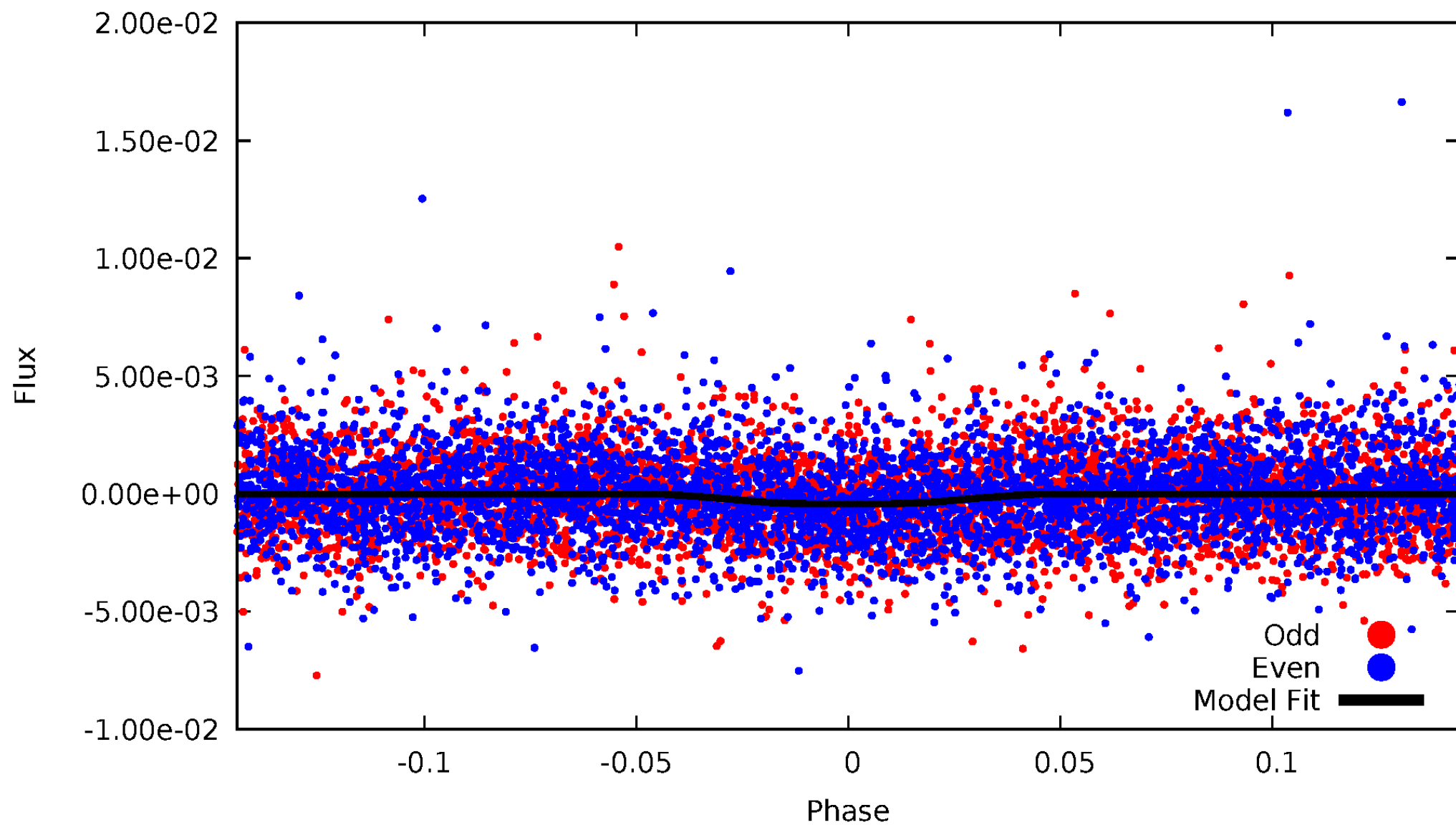
# TCE 009644411-02





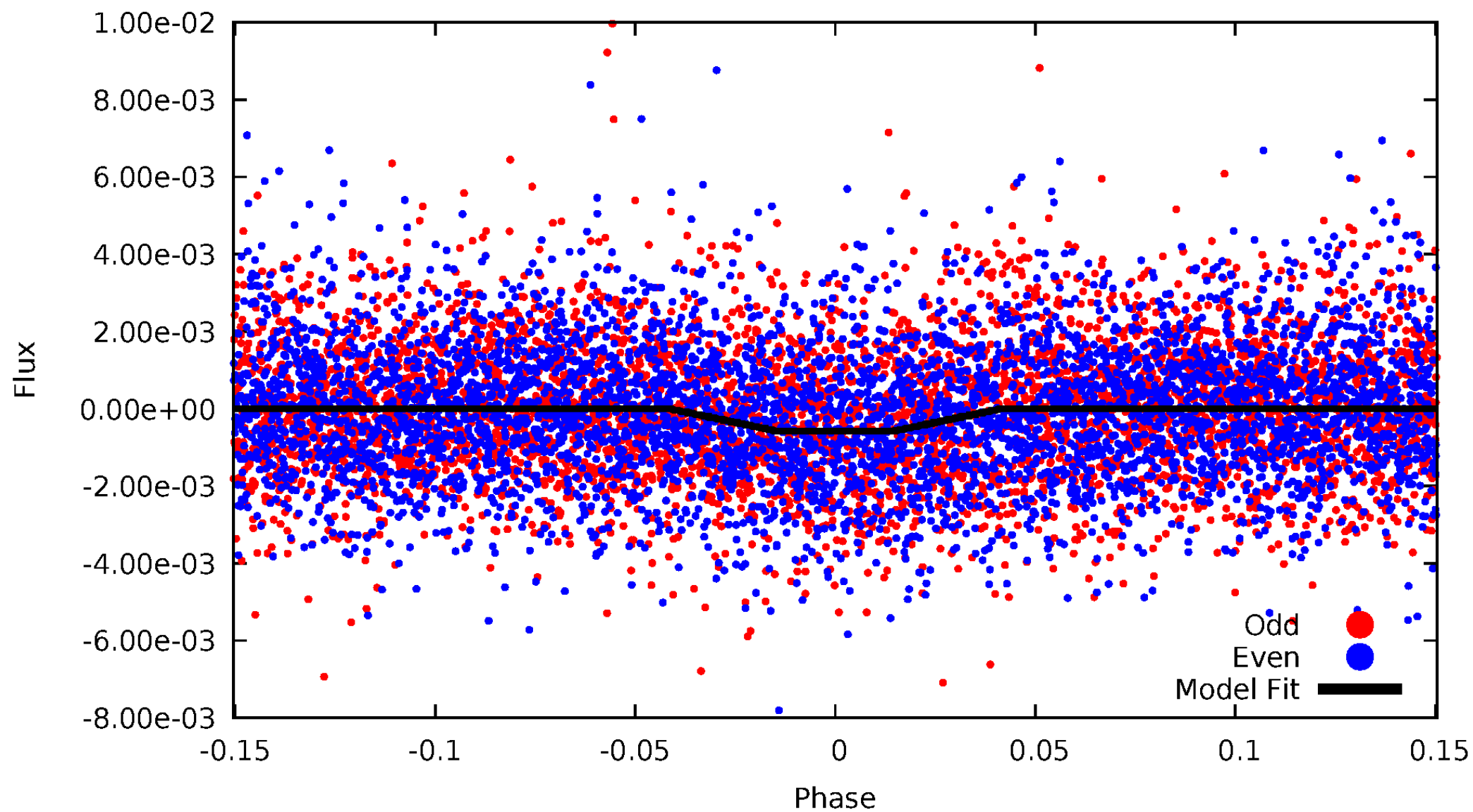
# DV Odd/Even

TCE 009644411-02



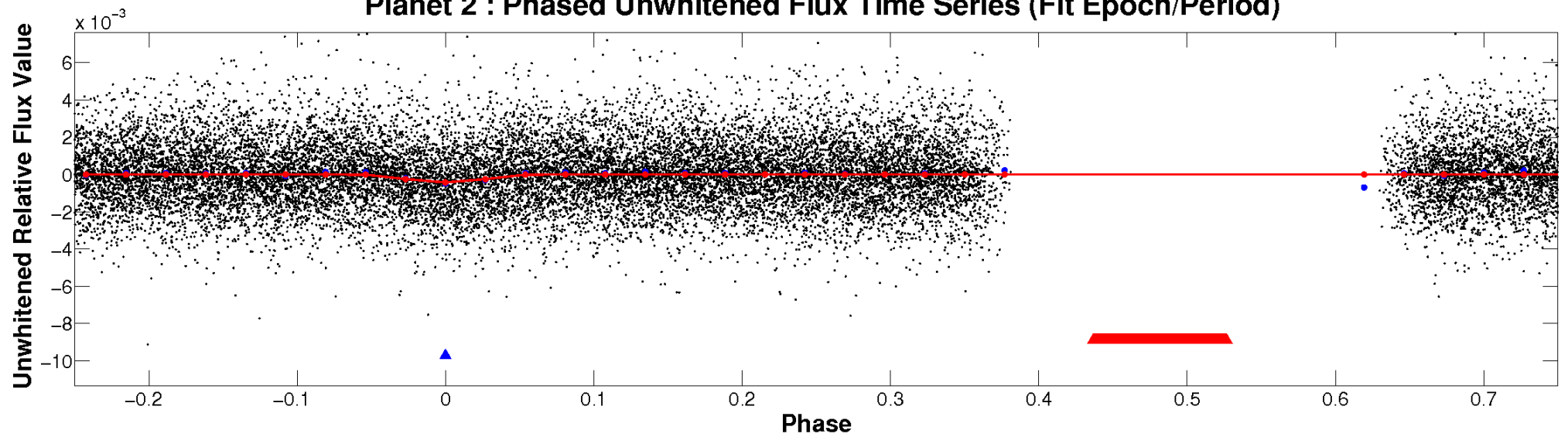
# ALT Odd/Even

TCE 009644411-02

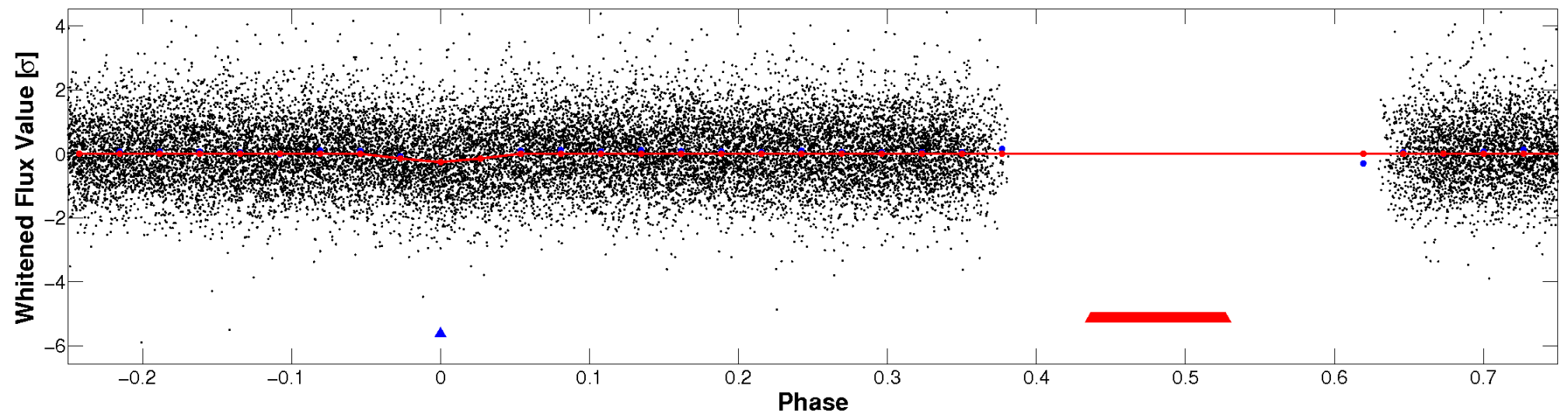


# Non-Whitened Vs. Whitened Light Curve

## Planet 2 : Phased Unwhitened Flux Time Series (Fit Epoch/Period)

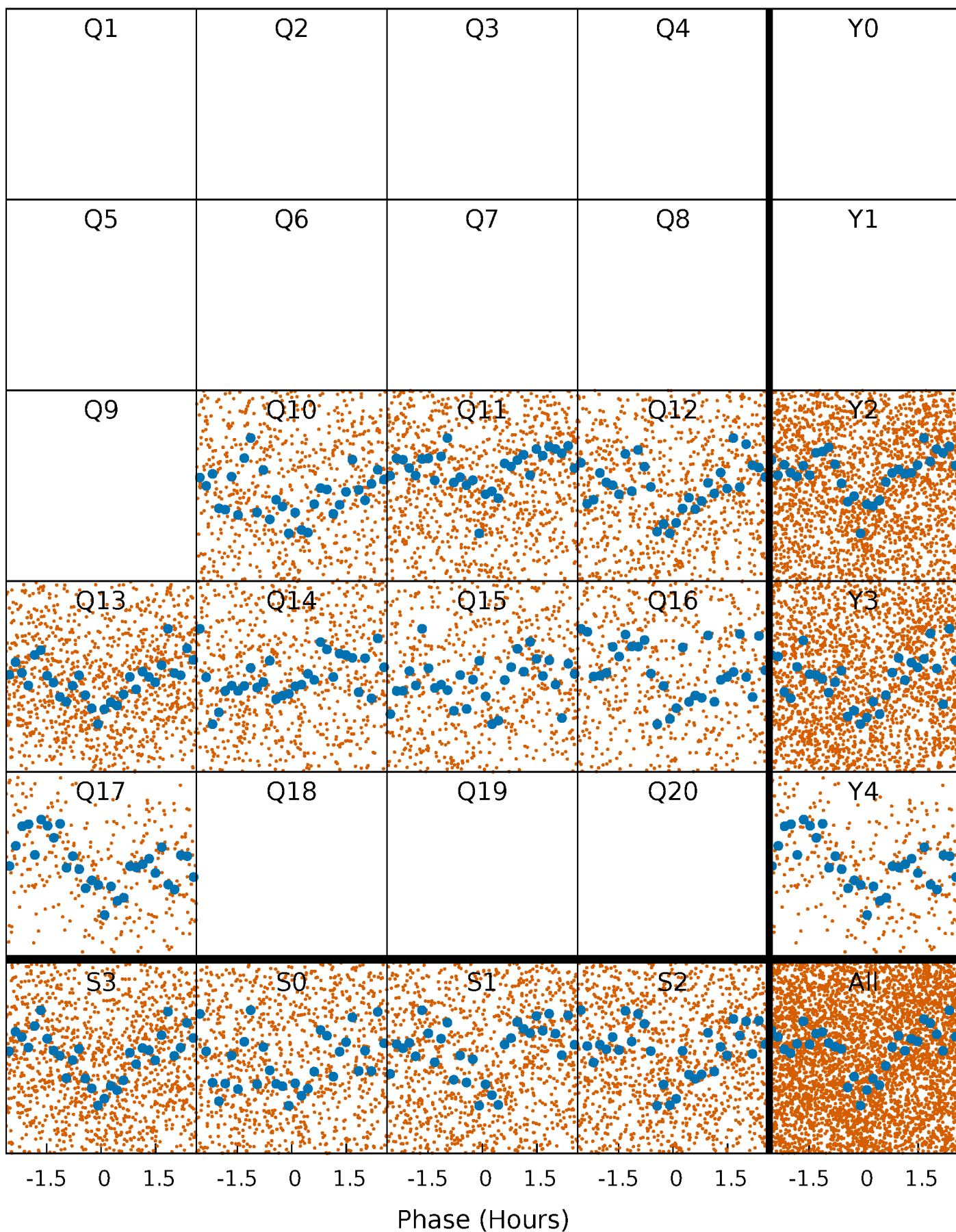


## Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)



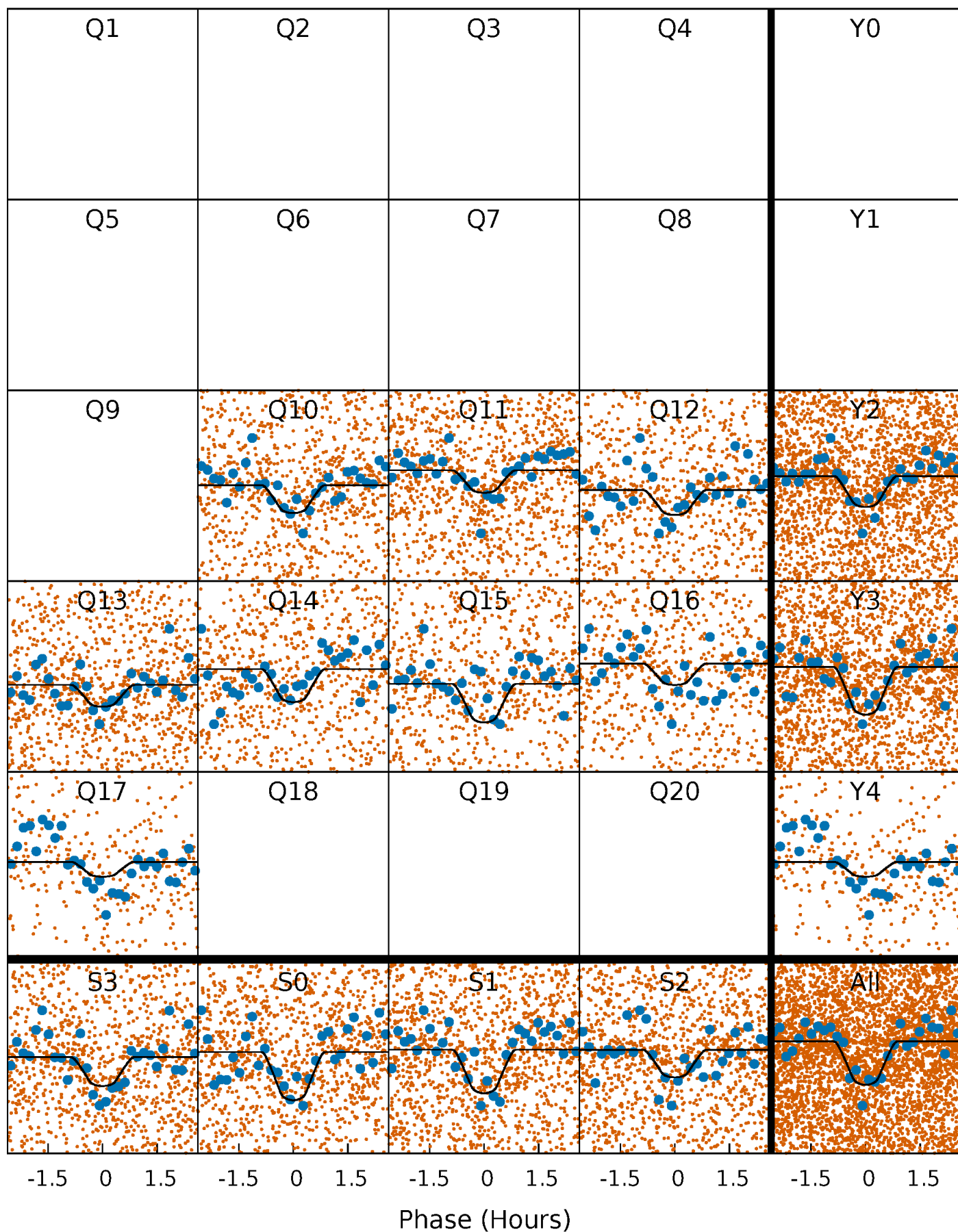
# PDC Quarter-Phased Transit Curves

TCE 009644411-02 P= 0.758819 Days  $T_0=131.617809$  (BKJD)



# DV Quarter-Phased Transit Curves

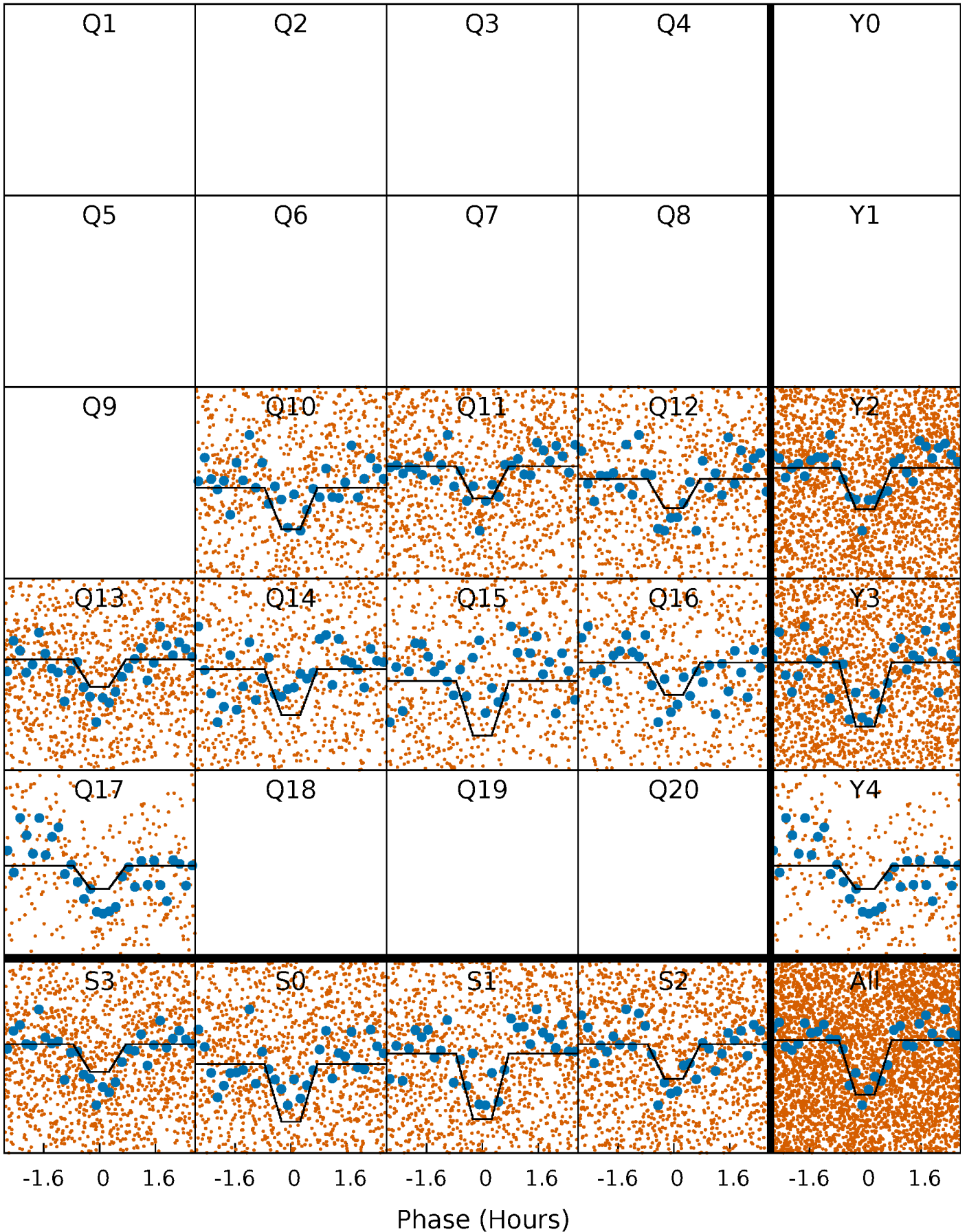
TCE 009644411-02     $P = 0.758819$  Days     $T_0 = 131.617809$  (BKJD)





# Alt. Detrend Quarter-Phased Transit Curves

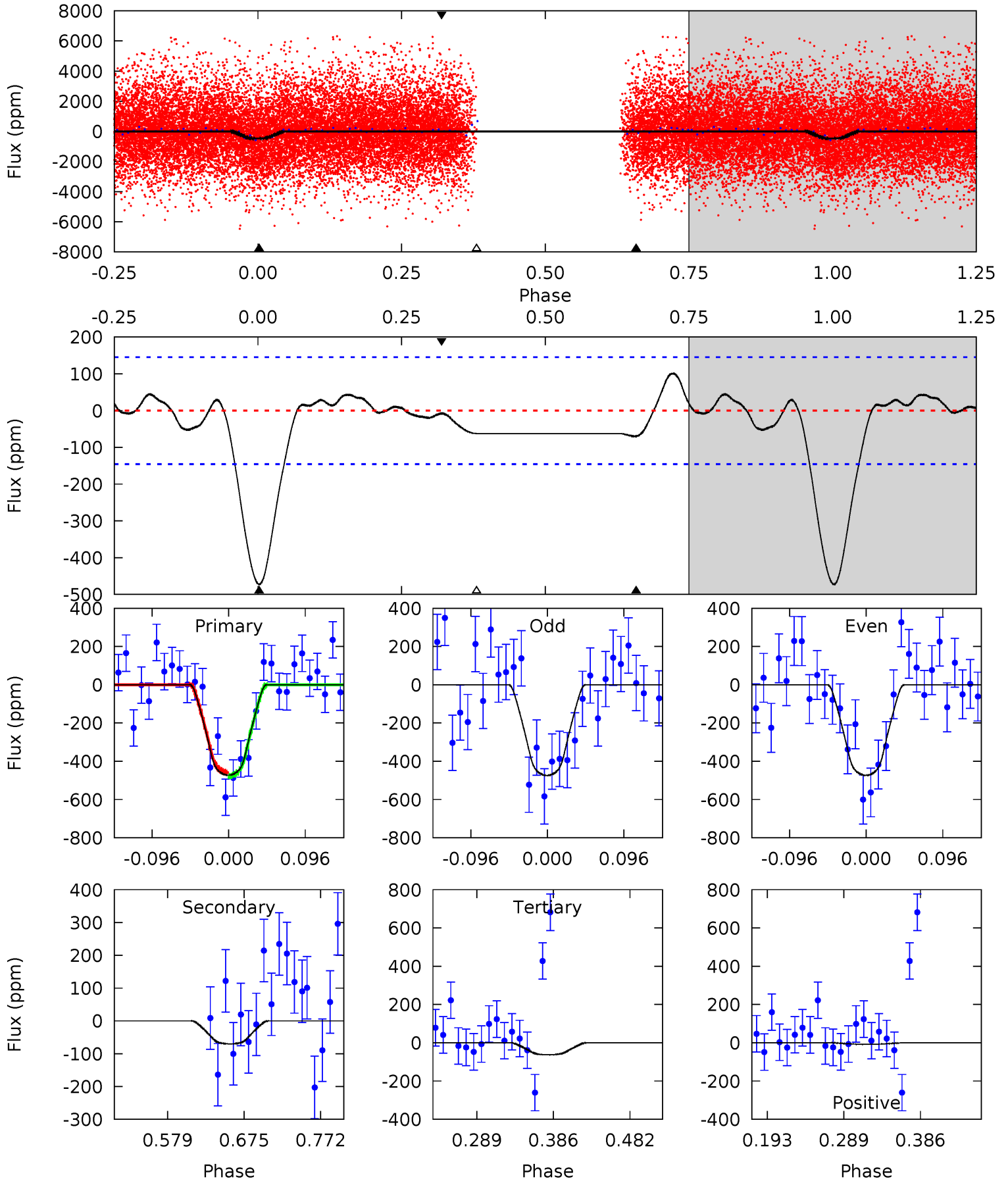
TCE 009644411-02   P= 0.758820 Days    $T_0=131.617351$  (BKJD)



# DV Model-Shift Uniqueness Test

009644411-02, P = 0.758819 Days, E = 131.617809 Days

Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
14.9	2.21	1.96	-0.24	4.57	1.66	0.84	12.9	15.1	0.24	2.45	0.01	0.94	0.18	0.29

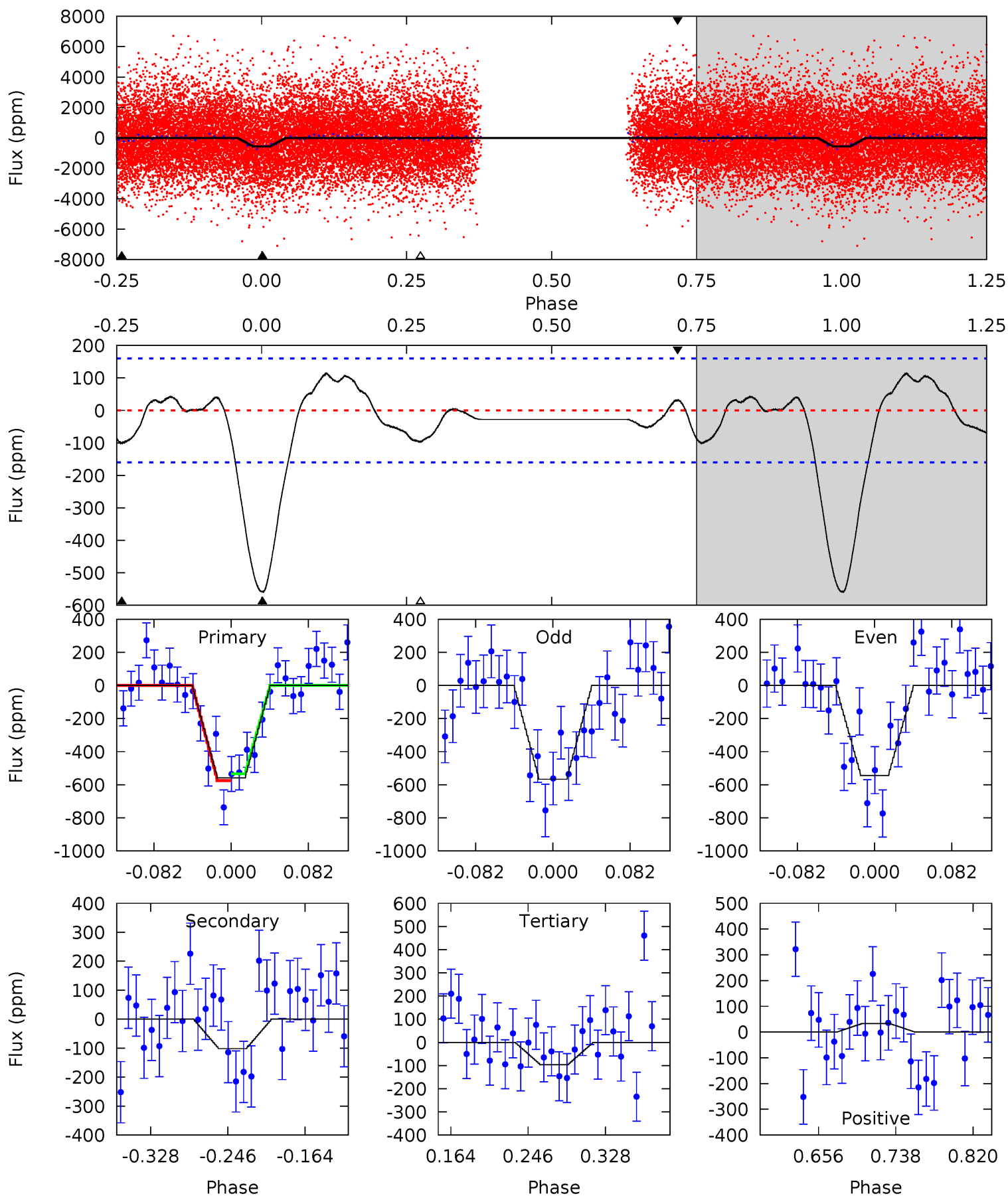




# Alt Model-Shift Uniqueness Test

009644411-02, P = 0.758820 Days, E = 131.617351 Days

Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
16.1	2.92	2.79	0.96	4.61	1.74	1.65	13.3	15.1	0.14	1.97	0.33	0.88	0.17	0.59



### Stellar Parameters For KIC 009644411

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$4331^{+151}_{-166}$	$4.620^{+0.042}_{-0.025}$	$0.070^{+0.250}_{-0.300}$	$0.666^{+0.041}_{-0.055}$	$0.675^{+0.051}_{-0.062}$	$3.216^{+0.634}_{-0.321}$
	+3%/-4%	+1%/-1%	+357%/-429%	+6%/-8%	+8%/-9%	+20%/-10%
Source	PHO54	PHO54	PHO54	DSEP		

KIC = Kepler Input Catalog; PHO = Photometry; SPE = Spectroscopy; AST = Asteroseismology  
 TRA = Transits; DESP = Dartmouth Models; MULT = Multiple Models

### Secondary Eclipse Parameters for KIC 009644411-02 / KOI

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{\text{max}} (K)$	$T_{\text{obs}} (K)$	$A_{\text{obs}}$
DV	$-70 \pm 32$	$2.08^{+1.70}_{-1.25}$	$1811^{+69}_{-73}$	$2809^{+1079}_{-682}$	$1.713^{+11.312}_{-1.269}$
Alt.	$-102 \pm 35$	$2.18^{+1.59}_{-1.32}$	$1819^{+70}_{-70}$	$2946^{+1117}_{-559}$	$2.309^{+12.627}_{-1.616}$

$T_{\text{max}}$  = Theoretical Maximum Planetary Temperature

$T_{\text{obs}}$  = Observed Planetary Temperature (Assuming  $A=0.3$ )

$A_{\text{obs}}$  = Observed Albedo (Assuming  $T=0$ )

If a secondary eclipse is present, the system is likely an EB if  $T_{\text{obs}} \gg T_{\text{max}}$  AND  $A_{\text{obs}} \gg 1.0$

## DV Centroid Data

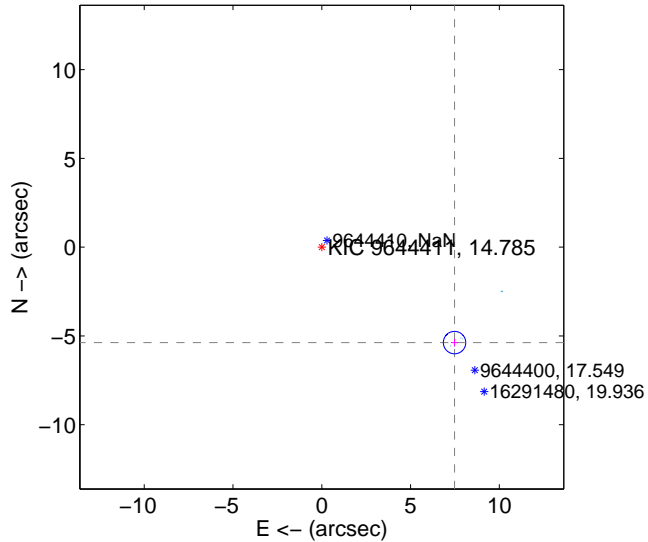
Supplemental centroid analysis for 009644411-02. Kepler magnitude: 14.79. Transit SNR 9.65

There are 5 quarters with good PRF difference image offsets

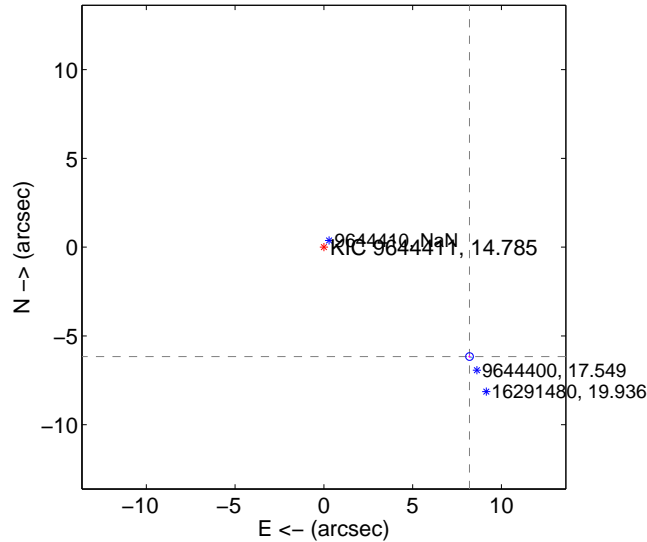
The OOT PRF centroid is offset from the target star catalog position by about 4.15 arcsec so the offset from difference PRF-fit to OOT-fit may be invalid.

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$9.208 \pm 0.210$	43.80	$-7.477 \pm 0.206$	$-5.374 \pm 0.218$
PRF-fit source offset from KIC position	$10.258 \pm 0.072$	142.68	$-8.202 \pm 0.070$	$-6.160 \pm 0.069$
photometric centroid source offset	$7.67 \pm 1.23$	6.25	$-6.13 \pm 1.27$	$-4.61 \pm 1.16$

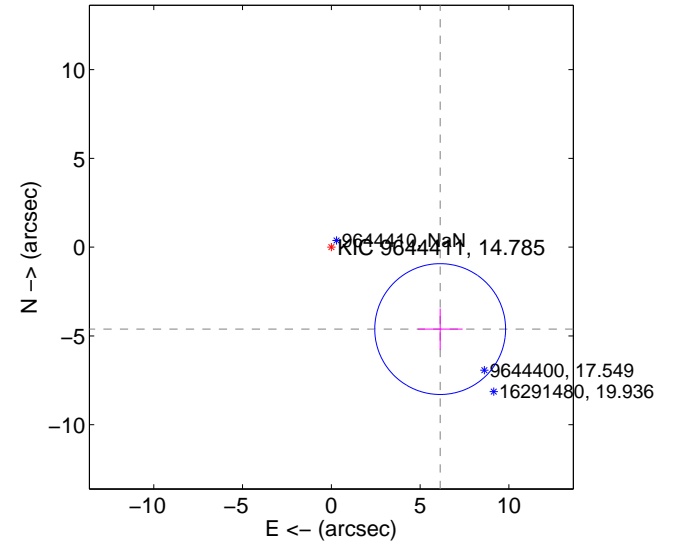
offset from difference PRF-fit to OOT PRF-fit



offset from difference PRF-fit to KIC position



offset from photometric centroids



Centroid source offsets from the target star reconstructed from PRF and photometric centroids. Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three- $\sigma$ . Red \*: target star. Blue \*: Other stars. Text next to a star gives its KIC ID and kepmag. KIC IDs > 15,000,000 are from the UKIRT catalog.

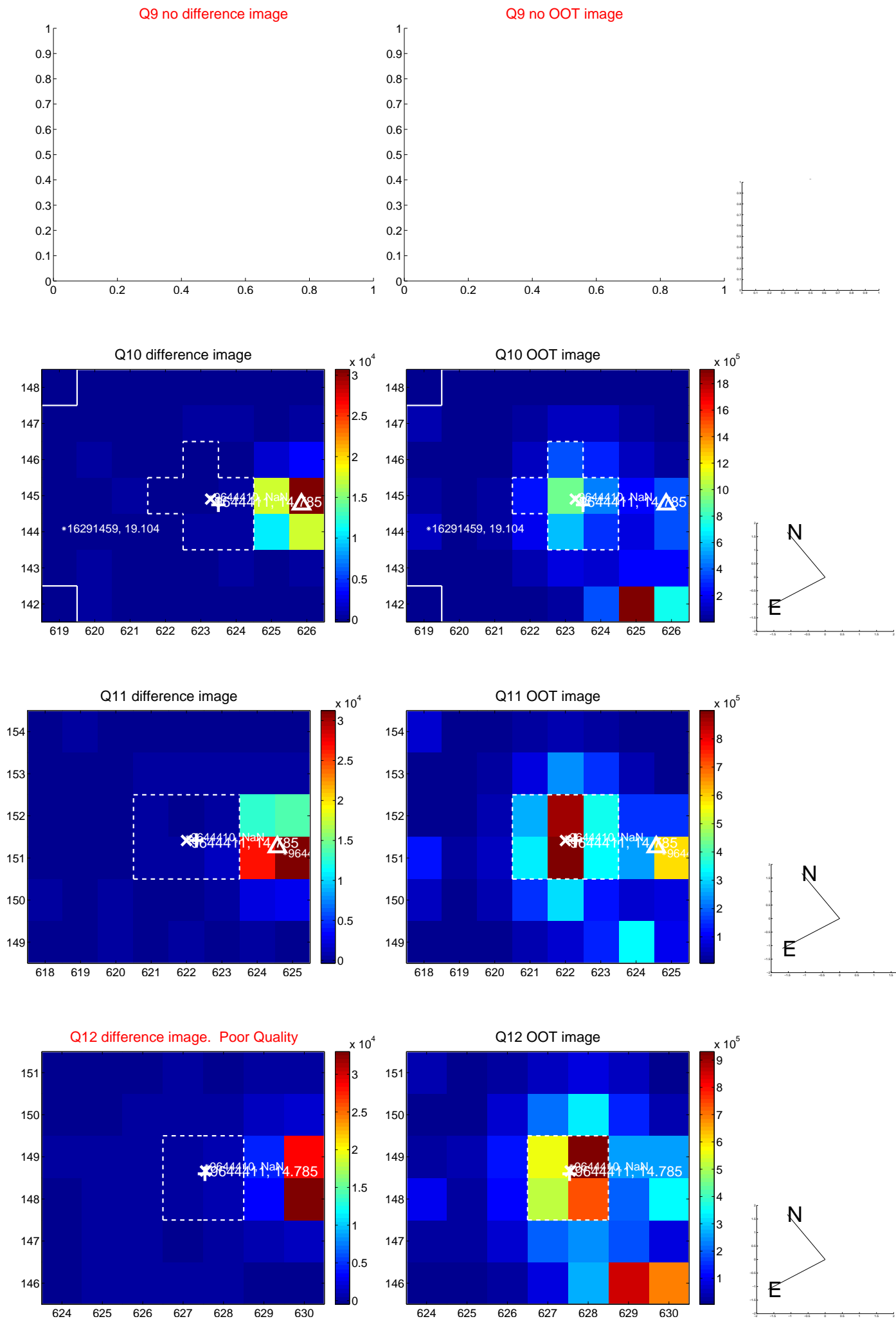
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



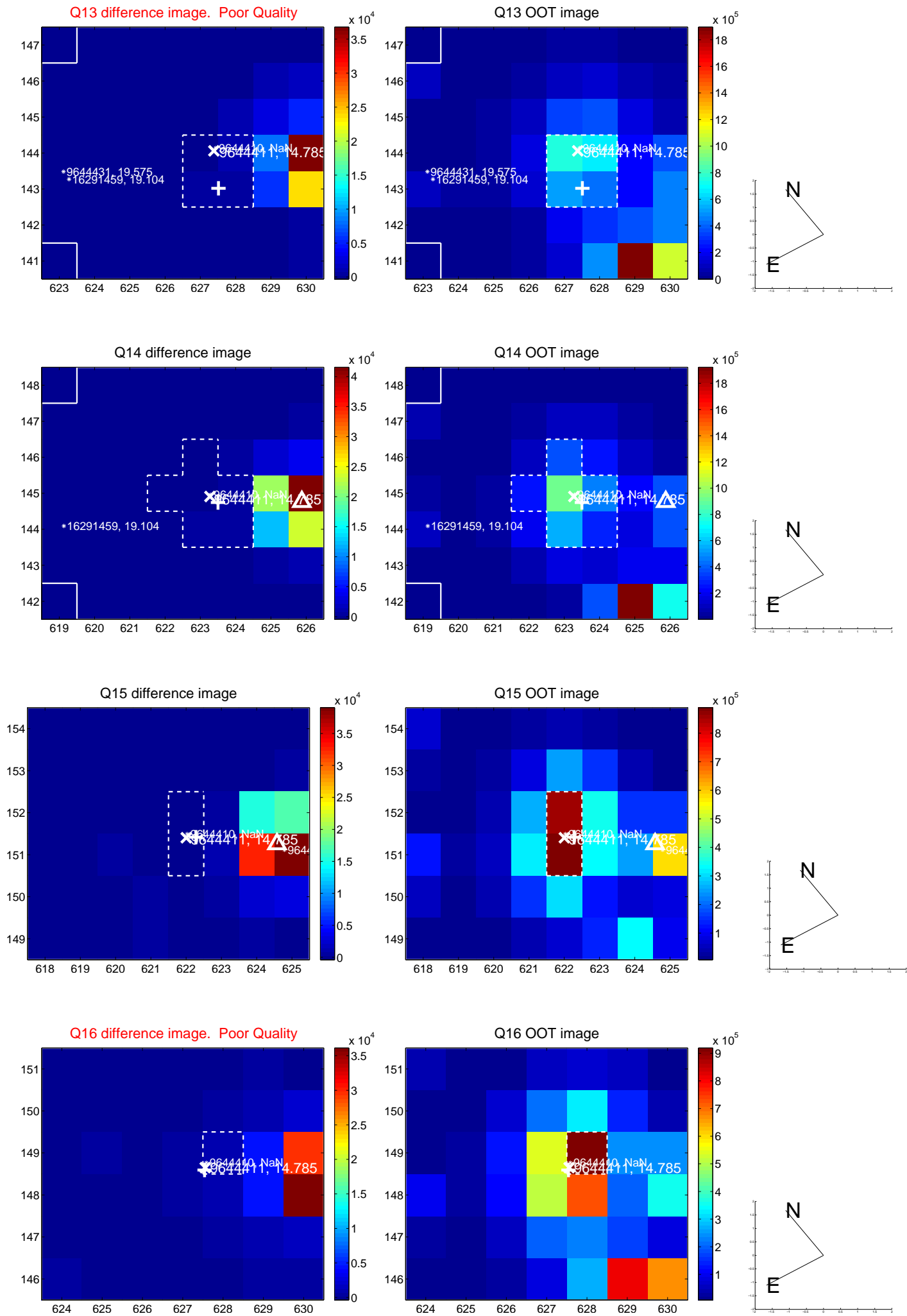
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

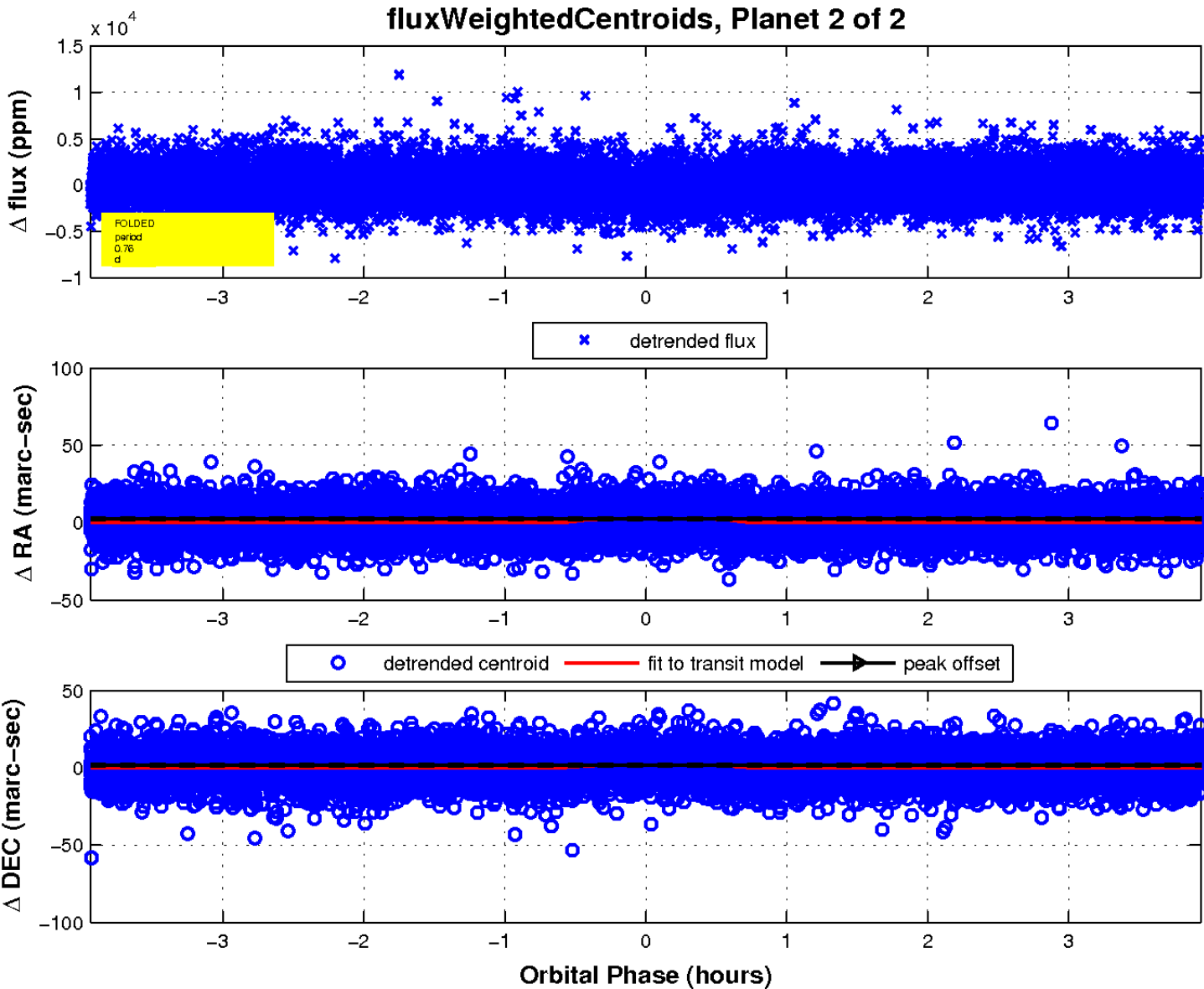
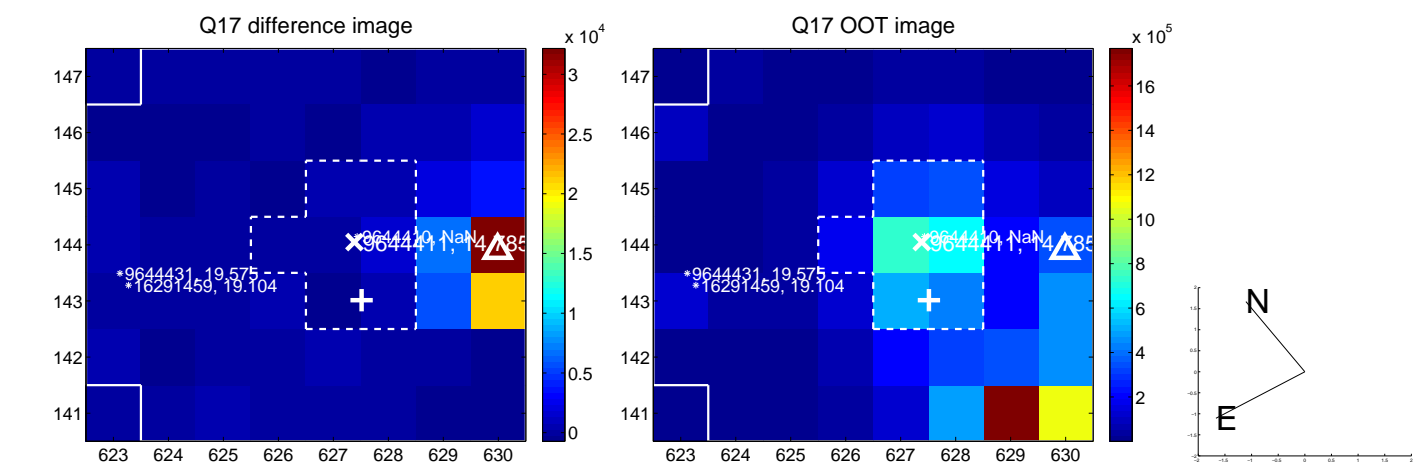


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.





white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



UKIRT Image

Declination

